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73 magazine

for radio amateurs

FEATURES

- SSTV – Monitor Kit Review
- ATV – IC Sync Gen
- RTTY – Anti-CW Autostart
- IC – 300 MHz Counter – One Chip AF Output
- MOBILE – Quick Band Change Antenna
- SOLID STATE – 6 Mtr Transmitter
- FM – Carrier Operated Relay
- SCIENCE – Radio Astronomy
- HF – Noise and Receiving Antennas
- LARSEN 2 Mtr Gain Antenna
- PICKERING Keyboard CW Keyer
- EXTRA CLASS STUDY GUIDE
- NEWS – Nauasa Expedition Set
  New OSCAR 6 Developments
  Armed Forces Day Operation
  W. VA. Flood Emergency
  Operations

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73 magazine
for radio amateurs
#140 MAY 1972

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73 Magazine is published monthly by 73, Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas. $7 per year elsewhere. Two years $11 in U.S. and $12 overseas. Three years $15, and $16 overseas. Second class postage paid at Peterborough NH, and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. *Entire contents copyright 1972 by 73 Inc., Peterborough NH 03458.* *Phone: 603-924-3873.* *Say, don't forget that little old tour of Europe this fall. You'll enjoy it a lot more amid cohorts who speak your own language, and you'll love meeting the European amateurs. Also, if you are within driving distance of FM West in Fresno on June 2, say hello to Wayne. He'll be there, working hard on the fight to save the 220 band from the chaos of 27 MHz. In May Wayne will be on from Navassa with the Atlanta gang as KC4DX, so don't miss that DXpedition. In June Wayne expects to be visiting Jordan again for a follow-up on his 1970 visit. In October it looks as if 73 will be exhibiting at the Hudson Convention for the first time in years . . . ! Keep the faith.*

Amateur Radio

MAY MCMLXXII — Monthly Ham News

AMATEUR RADIO WEEK PROCLAIMED

Mayor Walter Taylor, Englewood NJ signs a proclamation declaring June 18 to June 24 as Amateur Radio Week. Watching Mayor Taylor are WA2RIN, WA2NVG, and WA2CCF.

'72 ARMED FORCES DAY COMMUNICATIONS TESTS

Each year, on the third Saturday in May, the Department of Defense sponsors the observance of Armed Forces Day. This year's observance, the 23rd, will be held on Saturday, May 20, 1972. As in past years, as one of the many Armed Forces Day Programs and in recognition of the radio amateur's contributions to the field of communications, emergency services, and maintenance of morale among servicemen , the Departments of the Army, Navy and Air Force will conduct radio communication tests. These tests are designed to be a tangible demonstration of the firm and long-standing Department of Defense policy to encourage and support amateur radio activity.

The communication tests will consist of military-to-amateur crossband operations, using continuous wave (CW), voice (SSB) and radioteletypewriter (RTTY) modes of operation and "CW" and "RTTY" receiving tests. Special QSL cards confirming crossband communications will be forwarded to those amateurs who establish two-way contact with participating military stations.

A CW receiving test will be conducted for any person capable of copying International Morse Code at 25 words per minute. The CW broadcast will consist of a special Armed Forces Day message from the Secretary of Defense addressed to all radio amateurs and other participants.

A RTTY receiving test will be conducted for any station possessing the required equipment. This is a test of the operator's technical skill in aligning and adjusting his equipment, and serves to demonstrate the growing number of amateurs becoming skilled in this method of rapid communications. The RTTY broadcast will consist of a special Armed Forces Day message from the Secretary of Defense to all radioteletypewriter enthusiasts. The message will be transmitted at 60 words per minute.

HAMS PROVIDE LINK TO W.VA. FLOOD AREA

Reprinted from the Wheeling News Register, March 6, 1972.

As the death toll mounts and hope for the survival of the missing fades, amateur radio operators manning emergency communications in the Logan County disaster area are called to check the official death list with increasing frequency.

Since the Buffalo Hollow Creek flood tragedy 10 days ago, hundreds of ham radio operators have assisted in maintaining a precarious communications link with the devastated area and the outside world.

For C. W. "Gibby" Welsh of McMechen, ham radio operator since 1931, his kitchen-side radio room has been a front row seat on the disaster. He and his wife, appalled by the magnitude of the tragedy, marvel at the fortitude and perseverance of radio operators in keeping the air waves open 24 hours a day since the wall of water swept through the mining camp-dotted valley.

Within hours after the flood, a radio operator in Mallory, W. Va., two miles below Man on Buffalo Creek, sent out the first eye-witness reports of survivors, Welsh says. He stayed on the job for days until a net control was designated by the West Virginia Emergency Network.

Today station W8ETF in St. Albans, W. Va., is still receiving messages from friends and relatives of Buffalo Creek residents seeking news of their health and welfare.

Expressing his pride in the devoted service provided by the amateur radio operators, Welsh reports hearing of hundreds who volunteered their service during the ordeal since the flood. He isn't surprised, though, because ham radio operators have traditionally provided people-to-people contact throughout the world in time of need. The circle of friends ham operators acquire around the globe cover the world. Generally the contacts radio operators make are on a strictly for friendship basis. But when disaster strikes, they fill the breech left by downed telephone lines and washed out roads – or more often supply the communications link where no other exists.

"If everyone was an amateur radio operator, this would be a more peaceful world," says Gibby Welsh. In the meantime, everyone can share in the pride Welsh feels for the tremendous job being done by West Virginia's ham radio operators.

Relayed by Fred McGee, Moundsville, WV.

News Pages

ANTARCTIC DRAMA
HAM HELPS SAVE PLANES

On 28 February at 6:55 PST, amateur radio operator W6AJZ, Peter Lovelock, of Santa Monica, responded to an emergency call from KC4USP, National Science Foundation Radio at Palmer Station, Antarctica.

KC4USP reported that two Navy aircraft returning to Christchurch, New Zealand due to bad weather, were short of fuel and unlikely to make their destination. Due to abnormal radio conditions, Palmer Station was unable to make radio contact with Christchurch. W6AJZ responded to a call for help and was requested to phone Commander Osborne, Miami, Florida, and have him notify Christchurch by commercial communications that both aircraft were attempting alternate landing at Dunedin, New Zealand. It was urgently required that this airport implement emergency conditions including turning on all landing lights, field lights and adjacent city lighting to guide the troubled aircraft.

Apprised of the situation, Commander Osborne contacted Washington. Telephone contact with W6AJZ was then transferred to Captain Price-Lewis in Washington, where communications were already established with Christchurch. For the next 45 minutes all communications between Palmer Station and Washington/Christchurch were relayed via W6AJZ.

During this period Palmer reported radio contact had been lost with one of the aircraft. The aircraft's last known position was relayed to Washington and Christchurch. The commanding officer of Palmer Station declared a May-Day status.

Captain Lewis reported, for relay to Palmer, that all required emergency measures had been implemented at Dunedin Airport, and that air-sea rescue facilities on the South Island had been alerted. At 7:50 PST, with all emergency preparations in New Zealand confirmed by Captain Lewis, emergency radio contact with KC4USP and landline to Washington was secured.

Later that day Captain Lewis telephoned W6AJZ to advise that both aircraft had landed safely. A letter of March 3 from the National Science Foundation confirmed the safe return of the two Navy LC-130 transport aircraft with the assist of amateur radio communications.

CANADIAN NEWS

Courtesy of Canadian Amateur Radio Federation

Banned Countries List: Cyprus (amateur operations suspended except for operation on special occasions when call sign 5B4 will be used and communication with other countries is permitted), Gabon, Iraq, Khmer Republic (formerly Cambodia), Libya, Pakistan, Turkey, Yemen (Peoples Democratic Republic - formerly Southern Yemen) and Viet-Nam.

Third Party Traffic Agreements: Amateurs of Canada may exchange Third Party communications with the amateurs of the following countries: Bolivia, Chile, Costa Rica, Dominican Republic, El Salvador, Honduras, Israel, Mexico, Peru, U.S.A. (Territories and Possessions), Venezuela. Effective 12 March 1972: Trinidad and Tobago.

Reciprocal Licensing Agreements: All Commonwealth countries are eligible for reciprocal amateur operating privileges unless evidence that a country does not grant reciprocal operating privileges to Canadian amateurs. Canada also recognizes such agreements with the following countries: Belgium, Dominica, Dominican Republic, Ecuador, France, Fed. Rep. of Germany, Israel, Luxembourg, Mexico Netherlands, Nicaragua, Norway, Peru, Portugal, Rep. of Panama, Senegal, Sweden, Switzerland, U.S.A., Uruguay, and Venezuela.

SKYLARC PROPOSAL TURNED DOWN

The following letter was received recently from NASA concerning AMSAT's proposal to provide a ten-meter amateur station for NASA's SKYLAB manned orbiting laboratory scheduled for flight in 1973:

Dear Mr. Klein:

As you know, the AMSAT proposal to provide a radio amateur communications package for leisure time use by the crew on Skylab has been the subject of serious consideration within the Skylab Program for some time now, and more recently, by the top management of NASA.

It is with real regret that I must inform you that in spite of the broad appeal of your concept and a generally favorable disposition to encourage AMSAT activities, NASA has concluded that we cannot add it to Skylab at this stage of the program; and, therefore, we must reject your proposal.

The decision involved many factors difficult to summarize briefly, including concerns for the priority of this proposal relative to other program additions that are also under consideration, the funds for the necessary integration and testing, and concerns for even a small additional diversion of management and engineering attention at a critical time in an extremely complicated program.

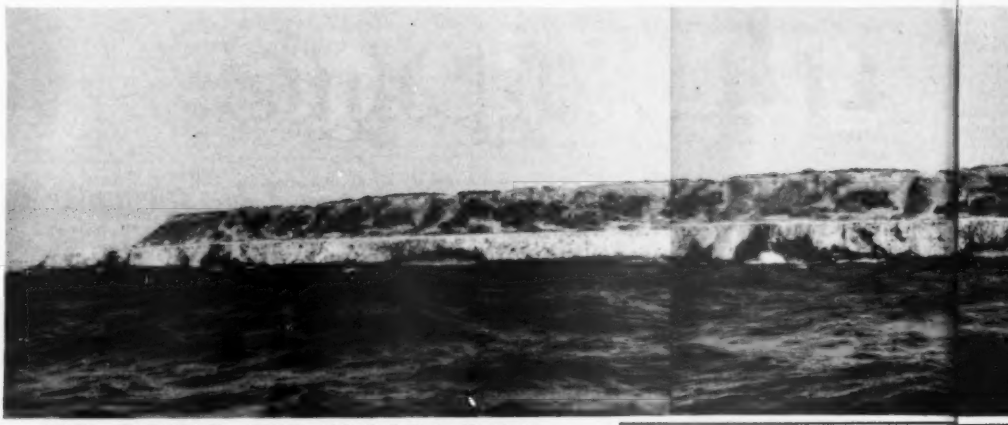
Our conclusion was not an easy one to reach. Considered by itself the proposal appeared feasible and reasonable – one that we could not reject out of hand. It may be of some solace to you that I brought the subject to the attention of Dr. Fletcher (NASA Administrator) and Dr. Low (Deputy Administrator) because of the uniqueness of the proposal and that the final decision was made by them, and then only with reluctance.

Should you desire, Mr. William Schneider, Director, Skylab Program, would be pleased to give you a more complete debriefing on our decision.

Sincerely,

Dale D. Myers
Associated Administrator
for Manned Space Flight

Reprinted from AMSAT Newsletter



73 GOES TO NAVASSA

One of the rarer spots in the world of the DXer is a little deserted island in the Caribbean not far from the stronghold of Papa Doc Junior . . . indeed the island, though it actually belongs to the United States, is claimed by Haiti. This erstwhile German prison island has been off-limits to everyone up until just recently, ever since the late 50's.

A group of Atlanta amateurs have organized an expedition to put Navassa on the air for three days in mid-May and have asked Editor-Publisher Wayne Green W2NSD to join the group. Permission has been obtained from the Coast Guard and the FCC has issued a special events call for the trip of KC4DX. The last call assigned for Navassa was issued to Wayne back in 1958 and was KC4AF. Wayne and five other amateurs visited the island at that time and in four days of around the clock operating rendered it un-rare for DXers.

You may be sure that the DXers will be reading the details of this exciting trip in 73, where it will be reported in full.

It is hoped that financial support will be obtained for a professional film of the expedition. Dave Bell, who produced the Hams Wide World film is interested in the project, and at least two major manufacturers have indicated an interest in the film.

Landing site at Navassa.

CW AWARD

To promote CW activity on six meters, Dennis McCormack, K1PLX, is awarding a special certificate to stations that work ten or more stations on CW or MCW. This is a great way for Technicians to improve their code while preparing for the General Class exam. Why not have a certificate that shows you operate this fun mode? It is a nice sign of accomplishment for anyone who operates six meters. The award is available for only a quarter in stamps, IRC, or cash from D. McCormack, K1PLX, $52, Box 329, Salem NH 03079. There are eleven different types of endorsements too.

General Bulletins for RTTY Ops

Call	Freq.	Shift	Day	Time	QTH
PAØAA	3600	850 Hz	Friday	2030Z	Sassenheim Holland
	14100				
	145.14				
W1AW	3625	1st copy	Monday	0300	Newington CT
	7095	850 Hz	Tuesday	2130	
	14095		Wednesday	2300	
	21095	2nd copy	Thursday	2130	
	28095	170 Hz	Friday	0300	
			Saturday	0300	
DL8CX	3585	850 Hz	Sunday	1030	Hamburg, West Germany
	3585	170 Hz	Wednesday	1800	

FLASH!

New OSCAR 6 Development

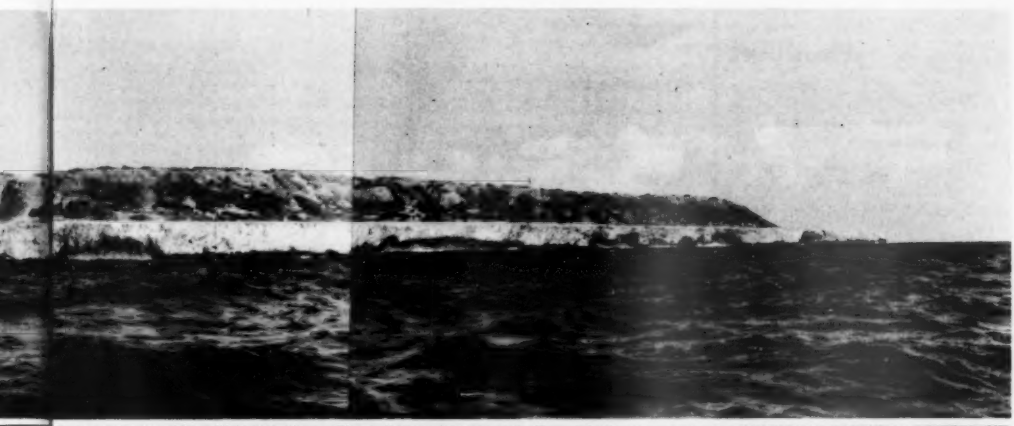
AMSAT has just announced that the OSCAR 6 active relay satellite 2 to 10 meter translator would operate in the non-inverting frequency mode. The launch is scheduled for July. The input transponder frequency range on 2 meters is from 145.90 to 146.00 MHz. The transponder output on 10 meters is from 29.45 to 29.55 MHz. The exact 10 meter output frequency can be calculated by subtracting 116.45 MHz from the 2 meter input frequency. Of course the output frequency can be plus or minus about 7 kHz due to Doppler shift on both the input and output frequencies. Manual 10 meter receiver tracking will be necessary on all modes except FM where AFC or a Phase locked Loop detector can be utilized. An example of the frequency translation is that if OSCAR 6 receives a 145.950 MHz input signal on 2 meters then the translator output frequency on 10 meters would be 29.500 MHz plus or minus the combined 2 and 10 meter Doppler shifts.

Horizontal linear polarization will be used on both the 2 and 10 meter antennas on the OSCAR 6 satellite.

SCHOLARSHIP ANNOUNCED

The Foundation for Amateur Radio, Inc., announces the annual award of the John Gore Memorial Scholarship for either graduate or undergraduate study. The Scholarship pays $500 for the academic year. Upon re-application, it is subject to being renewed for succeeding years.

Licensed radio amateurs who intend making a career in electronics or related sciences may now request the application for the academis year 1972–1973. Requests should be addressed to the Chairman, Scholarship Committee, 8101 Hampden Lane, Bethesda, Maryland, 20014. Requests for applications must be postmarked prior to May 31, 1972.



OBSERVATIONS ON THE SPACE CONFERENCE

Gary Allsman, W5UEW

Recently I had the opportunity to observe the amateur radio fraternity and one facet of its work from a position that not many of us from the hinterland, West Texas, often have the opportunity to do. I was fortunate to be in a position to take part in the preparation for and participate in the 1971 World Administrative Radio Conference for Space Telecommunications, WARC-ST, held this last summer in Geneva and thought the following comments would be appropriate on the eve of the A-O-C launch:

The Amateur-Satellite Service came out fairly well at the WARC-ST but things could have been better. And as one might expect, favorable amateur influence in a large number of delegations could have been greater.

The IARU, with AMSAT providing technical support, was present as official observers and carried the ball for the amateur community so far as on scene support was concerned. The IARU was highly respected by all delegations and provided a strong and necessary favorable influence for amateur matters at the Conference. (As a side light, some organization like the IARU must be on hand as a politically neutral source of information; often information from national delegations is looked upon as colored by national interests.)

But IARU presence at the Conference was not enough. A large majority of delegations come to a conference with a predetermined opinion on matters involving policy or politics in contrast to matters involving technical trade-offs. Amateur radio unfortunately often falls in the former category. This means the amateurs in each country must work to convince their own telecommunications officials to look favorably toward amateur matters before a conference begins. At a WARC each country has one vote and the favorable vote of just 8 or 9 additional countries at the Conference could have resulted in additional allocations for the Amateur-Satellite Service.

There is insufficient space here to try to categorize the various reasons why an administration comes to a conference with preconceived negative positions toward amateur radio. In a few smaller countries however these negative positions are often based on one or two negative encounters with individual amateurs or sometimes just a complete misunderstanding of what amateur radio really means and tries to do.

The activities of AMSAT provide new opportunities to educate high officials and provide favorable public relations. Possibly the glamour of space will open new doors and we can swing the telecommunications authorities in more countries around to see the advantages of making all aspects of amateur radio available to their citizens.

Reprinted from AMSAT Newsletter.

CW DX MOBILE

Congratulations to W6AM, Don, who has worked 176 countries from his mobile station during normal to and from work driving, about one hour per day average. He runs 1 KW on CW in the mobile.

Courtesy of the Hamrag

BIRMINGHAMFEST

The "Birminghamfest" this year will be on Sunday, May 7, at the Exhibition Hall at the Alabama State Fairgrounds near Five Points West in Birmingham. For entertainment, prizes, contests, net meetings, eyeball QSO's and fun for the entire family, plan to attend. For further information contact the Birmingham Amateur Radio Club, W4CUE, P.O. Box 603, Birmingham AL 35201.

WHERE IT'S AT!

SSTV FREQUENCIES

3.845
14.230
21.360
28.680

RTTY FREQUENCIES

3.625
7.095
14.075 autostart
14.095
21.095
28.095
146.70 (AFSK)

ARRL CODE PRACTICE AND BULLETIN FREQUENCIES (MHz)

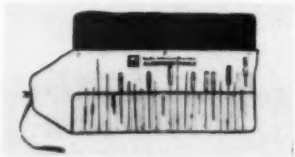
1.805
3.580
7.080
14.080
21.080
28.080
50.080
145.588

ARRL PHONE BULLETIN FREQUENCIES (MHz)

1.820
3.990
7.290
14.290
21.390
28.590
145.588

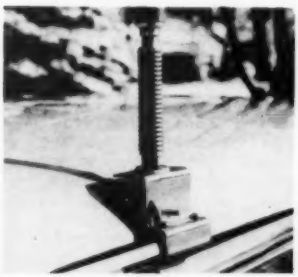
NEW PRODUCTS

New Alignment Tool Set



FMers and hams who just cannot find the right alignment tool now can keep all of these valuable instruments in one place. Jensen Tools and Alloys has come frequencies involved. Most receivers use interchangeable 45 MHz crystals, the tools for ham and other communications services. All are insulated and they include a long-reach core aligner, i-f transformer aligner, some special TV aligning rods, slotted tip, recessed tip, and hex style tips are all included. The pouch rolls up neatly and folds over so the tools can never fall out to be stepped on and broken. Under $17, it is available from *Jensen Tools and Alloys, 4117 N. 44th St., Phoenix AZ 85018.*

Mobile Antenna Gutter Mount



Here's new convenience in a rugged, all stainless mobile antenna gutter mount. The unit installs quickly with only a screw driver, is self-grounding and no holes are required in the auto body. Surprising signal results are received using a small spring and resonator only mounted on the 3/8-24 stud – no mast section is required. Also, it is easy to reach out the window and pull down the antenna for garages and other obstructions.

Add a small protective strip under the clamp screws and the bracket becomes a very strong trunk lid mount! When used with small transceivers (cigarette lighter plug-in) you can be mobiling in any car or truck in a very few minutes.

Priced at $7.95, it is available from *Rejsa Engineering Co., 7632 Plymouth Ave. N., Minneapolis, MN 55427.* (Spring, resonator and coax not included.)

REPEATER UPDATE

LISTENING
94 76 88 73 70 64 82. . .

AL	W4QEE	Mobile	22–82
AL	WB4QGL	Montgomery	34–94
AL	W4MWF	Montgomery	16–79
AK	KL7USA	Anchorage	34–94
CO		Denver (RTTY)	10–70
CT	WA1JTB	Bridgeport	146.295–146.895
DE	K3SVA (now WA3KWE)		
IA	WA0SNS	Waterloo T2.1	34–94
IL	WB9ADW	Genoa	13–73
IL	WA9LIV	Waukegan	146.75–146.55
IL	WB9INC	Hinsdale T2.0 (formerly WB9HWS)	73–01
KY	W4YWH	Highland Heights	19–79
MA	W1EMB	Everett PL 88.5	13–73
MA	K1AIU	Framington change to 146.55–147.15	
MA	K1UZR	Bellingham	146.46–147.06
MD	W3IJX	Frederick	13–73
MI	WA5RMS	Gautier	28–88
MN	W0GKP	Duluth	34–94
MO	WA0ZIK	Eldon	28–88
NY		Brooklyn	146.205–146.805
OH	WB8COK	Dayton	16–76
PA	WA3NOF	Lancaster	01–81
FOREIGN			
Canada			
	VE1AEH	Mt. Blomidon (N.S.)	146.58–147.18
	VE1HI	Charlottetown (PEI)	34–94

Thanks to W4CNQ, WB9ADW, K1SOP/KR6, W1HBH, K1AIU, K1MON, WA9AFM/0, VE1SH, WB9HWS, W3IJF, WA2HVK, W3FEY, WA5RMS, WN0BAV, K3NOQ.

LETTERS

I wholeheartedly agree with the idea of using 146.52 as a simplex channel and will do all I can to promote 52 as suggested.

Ron WA1PMS
Arrow Electronics
Norwalk CT

Following is a letter to the editor of the LIMARC Log:

Dear Ed:

On Thursday, Jan. 13, I was in Dayton Ohio with my TR-22 and I had the pleasure of participating in a ham radio function that was unique in my (too many) years of experience. I think LIMARC could benefit from the approach the Miami Valley Amateur Radio Club takes in using and policing their impressive repeater system.

At exactly 7:30 a net control stations signs on 146.76 (I understand they're changing to 146.64, but that's beside the point). He solicits check-in's and just logs calls as fast as he can. He announces that this is a regular meeting of the club, that each check-in will have a chance to be heard and after a brief "business" meeting there will be a technical talk by one of the members.

By 7:40 thirty amateurs had checked in, including W2NM. Net control then solicited comments from each check-in in the order they checked in. Comments ranged from complaints about rag-chewing (and a restatement of the club policy regarding same – they discourage rag chews on the repeater) to quality of signals and very brief descriptions of equipment that individual members wanted to get rid of. Such offers were followed by a brief pause, and in almost all cases arrangements were made for "land line" contacts to discuss details.

When it came my turn one of the members broke in and asked me to tell them about New York repeater operations. They were impressed and very interested. You should have heard the groans when I gave them the LIMARC frequencies. They were also surprised to learn that there was no useful 34/76 repeater in the New York area.

After a very brief business session, certain committees reporting (such as an apparently effective crystal acquisition committee) one of the members spoke on receiver trouble-shooting. He was most enlightening, and he let the repeater drop periodically for questions – which were frequent and very intelligent.

The technical talk was followed by a general roundtable and some pleasant yakking.

So an excellent meeting was held, information exchanged, club policy restated, equipment exchanged, etc., and nobody left the comfort of his home! (By the way it was snowing and very cold.)

You might consider a similar operation for LIMARC. It works!

Jim Fahnestock W1NM

WITH THE FCC

The Fiscal Year 1970 FCC Report includes a comment that 2491 violation notices were issued aginst hams, as compared to 2464 in 1969. One percent of the American ham population is not bad, but it should not be that high. Many notices were due to lower class licensees operating in band segments reserved for higher class licenses. The Citizens Radio Service had 1409 notices in 1970 as compared to 2400 in 1969. There seems to be little effort to catch illegal CBers or else it is very difficult to identify people who do not give any identification. It is unknown at this time what proportion of the ham violation notices led to further FCC action as compared to those of the Citizens Band.

To mark the 75th anniversary of the Marconi Kemp Tests of 1897, the Barry College of Further Education Radio Society is issuing an award, in the form of a certificate, to radio amateurs who provide proof of contact with Commemorative Stations, established in various parts of the world, and amateur radio stations in Italy and Britain.The award will be made available to amateurs and short wave listeners for a period of approximately 12 months, starting on May 13, 1972 with the establishment of the Bristol Channel Commemorative stations at Lavernock Point, Flatholm Island and Brean Down, and ending May 31, 1973. All questions and comments should be addressed to the Awards Committee, Barry College of Further Education Radio Society, College of Further Education, Colcot Road, Barry, Glamorgan, England.

* * *

The Lockheed Amateur Radio Club again sponsors the biggest annual ham convention in the Los Angeles area. The date this year is May 20 from 10 A.M. until 8 P.M. There will be an interesting program and prize drawings and a good time for all. The site will be at the Lockheed plant in Burbank, seven blocks east of the Hollywood-Burbank Airport.

* * *

The Baton Rouge ARC will hold its Eighth Annual Hamfest May 6 and 7 at Father Colbert's Camp, just east of Baton Rouge. Besides the Hospitality Room and evening awards banquet, there will be a Swap-Fest on Sunday, contests for high speed code, home brew building, and a demonstration of radio control airplane flying. On Sunday there will also be a giant picnic featuring Uton Diez, the world's "Champion Jambalaya Cooker."

* * *

The Rock River Radio Club will hold its annual hamfest on May 28 at the Lee County 4-H Center in Amboy IL. The indoor all-day event begins at 9 A.M. Free coffee and donuts will be served while you inspect the gear at the tables. Free camping area nearby. For further information, contact Carl Karlson, P.O. Box 99, Nachusa IL 61057.

The Wabash County Amateur Radio Club will hold its fourth annual hamfest at the Wabash County 4-H Fairgrounds, Wabash, Indiana, on Sunday, May 21, rain or shine. Admission is only $1. There will be no set-up charge for the flea market. Activities include technical talks, free Bingo for the XYL's, and door prizes. Free parking. Camping is available on the grounds Saturday night. For more information write Bob Mitting, 663 N. Spring St., Wabash, IN 46992.

* * *

The Maryland Mobileer Amateur Radio Club will sponsor a Hamfest on Sunday, May 21, at Anne Arundel Community College, starting at 10 A.M The college is 6 miles north of Annapolis, just east of Route 2. Talk-in on 7255 kHz, 146.94 and 146.16/76 MHz starting at 8 A.M. Plenty of parking; lots of goodies. For further information contact Donna Fournier, Secy. MMARC, R. 1, Box 154, Discus Mill Road, Severn MD 21144.

* * *

USAF MARS Region 1 Convention will be held at the Statler-Hilton Hotel, Boston, Mass. on 19, 20 and 21 May. Lectures, demonstrations, exhibits, forums, eyeball QSO's, social events and a banquet highlight the affair. All interested radio amateurs are encouraged to attend. Contact WA1PBJ, John Donovan, 19 Pratts Junction Road, Lancaster RFD, MA 01523 for tickets and information.

* * *

The P.H.D. Amateur Radio Association will sponsor the third annual Northwest Missouri Hamfest to be held at Claycomo, Missouri on Sunday, May 7, 1972, from 9:30 A.M. till 4:30 P.M. The location will be in the U.A.W. hall across from the Claycomo Ford Plant on U.S. Highway 69 Alternate. This event draws the most active amateur radio operators from the states of Kansas, Nebraska, Iowa and Missouri.

* * *

The Annual Humboldt Amateur Radio Club Hamfest will be held Sunday afternoon, May 21, at the Shady Acres City Park, Trenton, Tenn. There will be door prizes, flea market, ladies' activities, and a playground for the children. For further information contact W4IGW, Edgar Holmes, 501 N. 18th Ave., Humboldt, TN 38343.

* * *

Free code and theory classes for ham licenses are held every Wednesday night at 8 P.M. at Land of Electronics, 400 South Main St., Lombard IL. Call Phil, K9DTB, for info (312) 495-1234.

The 39th annual Western New York Hamfest and VHF conference will be held in Rochester, N.Y. the weekend of May 12–13.

Activities start Friday, May 12th at the Rowntowner Motor Inn, 800 Jefferson Road (14623), new Hamfest headquarters.

Registration for this fabulous day is only $3. Combined registration and banquet in advance is only $7. Advance sale closes May 6. There will be only a very limited number of banquet tickets available at the gate. Write: WNY Hamfest, Box 1388, Rochester, N.Y. 14603.

The New York Chapter of the National Awards Hunters Club offers several awards for working various proportions of New York State hams. For more information about these certificates, write to Joseph Tricarico, WA2MWO, 338 Madison Ave., West Hempstead NY 11552.

Worked New Brunswick Counties Award

This award requires QSL cards from twelve counties of New Brunswick, each showing county, date, band, frequency, mode, and operator's name. Send cards to H. W. Gammon, VE1PM, 357 St. Andrews St., Bathurst, N.B., Canada.

PENNSYLVANIA

The annual Presque Isle Amateur Radio Club banquet will be held May 20, 1972 at the Concord Inn at North East PA. Social hour will be from 6:30 to 8 P.M. Dinner will be served at 8 P.M. The price is $5.00 per person. For more info write PARC, P.O. Box 1021, Erie PA or call AC 814 866-0491.

On May 21st, the Breezeshooters Eighteenth Annual Hamfest will be held at White Swan Park near Pittsburgh. This is the largest ham gathering of its kind in the area. Contact K3FGQ for more info.

* * *

The Sharon ARA will be holding a ham auction on Saturday, May 20, at the QTH of WA1LXE. The auction will begin at 1 P.M. Directions available by writing to Dave Fisher WA1LXE, 30 Ames Court, Sharon, Mass.

* * *

The Yellow Thunder ARC will hold its annual hamfest on May 27 at the Dellview Hotel, Lake Welton WI. For further information, contact Al Gallagher WB9BPL, 401 Market St., Lodi WI 53555.

EDITORIAL BY WAYNE GREEN

SCANNING GREEN

While some of the chaps on slow scan television have built their own monitors and cameras, and some have gone the EKY Video Vision kit route, most of the ops have gone first class with the Robot monitor and camera systems.

Imagine the chagrin of the chap who has spent nearly a kilobuck and finds he is now able to see Wayne Green making faces.

The Robot monitor and camera arrived the other day and everything else ground to a halt. Within a couple of hours the mating plugs had been made up and we were on the air with slow scan television.

The connections are simple . . . the monitor plugs into the regular mike input of the rig and the mike then plugs into the monitor so you can talk normally or switch over to sending pictures. The audio for the monitor is picked up off the speaker of the receiver. The camera plugs into the monitor and you're ready to go.

The first day on television we made do with signs propped in front of the camera which were produced with a broad black felt pen. The very first QSO was with W6IFL and Pete helped us adjust the contrast and brightness controls on the camera. Next came KL7HEE, then HK5HK and HK5BFK, KH6DEH . . . etc. All of these were what is called "closed circuit" . . . the pictures came in just as if they were from our own camera.

The next day we broke from work for a few minutes to see what might be coming in from Europe . . . ho, ho . . . HA7LF . . . not closed circuit with all that afternoon QRM, but perfectly readable. Mel W8UUS, an old friend of ours of twenty years standing, swapped pictures . . . then W1PFA from over in the eastern sector of New Hampshire for state number three. Bill's demo of the Robot system at a recent K1MNS repeater group meeting was one of the last straws that pushed us over the hill into getting on slow scan. You can talk about it and read about it, but until you see it you can manage to ignore it.

When Bill discovered that we were on SSTV he sent over a menu board for us to use. This is a black board with white plastic letters that can be stuck on in moments. With this contraption we are able to put the call letters of the station we are contacting up on it and make an instant on the air QSL. We rigged up the board to say, "Hi 4X4VB QSL de W2NSD/1 New Ham Shire 20 MAR 72, WAYNE — 73." All we do is change the call and show a few frames of this to QSL each contact. It becomes a CQ call by setting up a CQ in place of the DX call and QSL.

Once you start seeing the pictures of the fellows you are contacting you realize there is a lot of truth in the proverb about the difference between a man and a boy being the cost of his toys. But what a toy! On the second day of viewing we swapped pictures with VK5MF and three I's . . . then came the DX contest and all bets were off for the weekend of intense QRM. Oh well, we did pick up a long "needed" FM7 contact during the contest for an extra country . . . we're around 300 now somewhere on 20 phone.

Day by day the slow scan countries and states are building up . . . the main problem is an almost total lack of time to operate. We can get in a few short contacts on FM from the car while taking Sage to the day care center or while going downtown shopping, but we don't have the repeater connected to the 20m rig yet so we're stuck down on 2m via W1ALE in Concord to a cross band on 6m. There is precious little activity on 52.525 except when the band is open and we can work W4's by the gross via the repeater. Other than that the main attraction is K1IIG down in Hartford who has a 450 repeater with output on 52.525.

We're up to 20 countries on slow scan, despite the limited time . . . perhaps an hour every other day. The latest was 4X4VB, our first Asian QSO . . . leaving only Africa for WAC. Since ARRL seems to have refused to provide an SSTV endorsement for their WAS and WAC certificates, it seems likely that 73 will try to plug this hole in the dike. There are some active African SSTVers, so WAC should come shortly.

What can you say about the excitement of sitting there watching live pictures from a DX station? Or from a friend you haven't seen for a while. The pictures are remarkably good, considering the limitations of the medium. In order to get the bandwidth down to ham band proportions it is necessary to effect some small economies here and there. A regular television pictures requires about 4,000 kHz bandwidth. In order to shoehorn this big thing into the 20m phone band we have to prune it by sending somewhat fewer pictures a second and fewer lines per picture. Fast scan runs 60 pictures per second . . . so if we chop that down to one every 8 seconds we have about 1/500th as many pictures to send per second . . . a dandy saving. If we cut the number of lines from 440 down to 120 we have cut another 1/4 . . . a total of about 1/2000th as much information per second . . . or about 2 kHz bandwidth instead of 4 MHz.

With pictures taking 8 seconds you have to hold still when you are shooting it "live."

Many of the ops are using the Robot monitor for receiving and using tape recorded signals for sending pictures. Robot will make up tapes for you . . . and so will any owner of a camera, so it is no big problem. Buster W9WED takes his cassette recorder along mobile and makes two-way slow scan contacts all with his recorder, sending his pictures from one cassette and recording the incoming pictures on another cassette. He then plays the tape into his monitor when he gets home and there are the pictures. He has several countries and a bunch of states worked two way mobile slow scan already.

There are at least 45 countries on slow scan for W8YEK has worked that many. You'll find a list of these contacts in the slow scan column this month.

ADDITIONS TO 73 STAFF

Yvette Grimes (WA8ULU (we all ate Uncle Louie's Underwear) has joined the crew at 73 as Assistant Publisher, an omnibus category which entails producing the 73 books and hypoing subscriptions among a long list of lesser duties.

Yvette is getting out several interesting books, including one on How To Use FM, written by W2NSD/1, a book of digital control circuits for repeaters, a book on slow scan television, one on converting commercial FM equipment, a book on 432 MHz construction projects, a transistor project book, and many, many others. She has her hands full.

Lin Green, wife of the publisher, has taken on the thankless job of Advertising Manager. This job involves an almost unlimited amount of details, the missing of any of which will probably result in the total alienation of at least one advertiser. Keeping the ads for eighty or so advertisers in each

issue of 73 plus those in the Repeater Bulletin all in order is a tough job.

Ed Webb W4FQM has signed on as Technical Editor of 73. Ed brings considerable design experience in solid state and IC's. Ed has considerable experience in RTTY, FM, SSTV and several other areas of the hobby. Watch for a lot more IC project material in 73.

HAM CELEBRITIES

W2NSD/1

Some amateurs are so starved for a celebrity to hound off the air that they will even tackle W2NSD/1.

Seriously, would you like to hear King Hussein on the air more often? Would you like to hear Arthur Godfrey around the bands? How about Barry Goldwater? Andy Devine? These fellows . . . and more . . . will be active and on our bands if only you will let them.

Put the shoe on the other foot for a moment. How long would you stay active on the bands if every time you gave your call you were forced off the air with breakers? Would you continue to ham if you found an enormous pileup every time you stood by? Would you enjoy the hobby at all if there was virtually no way to complete a contact? And if you get mad and complain then you are a bad guy

The next time you hear someone well known on the air why not just enjoy listening to him . . . or her? Help them to enjoy amateur radio so they will be with us longer. Jordon is certainly not rare anymore, so why not let King Hussein make some contacts without immediately jamming him right off the air as soon as you hear him? You lose . . . he loses . . . we all lose. The other evening I heard JY1 make a contact with someone he knew . . . and as soon as it was over the screams of anguished amateurs demanding a contact were heard nonstop for about ten minutes. One W4 called over 200 times! And he already had worked JY1, I remember working him from there.

We will have friends if we deserve them. Please, the next time you hear this nonsense going on, take the time to go on frequency and explain to the mob that they are helping to make life miserable for someone who should be a friend of amateur radio.

IS 220 MHz REALLY LOST?

The EIA seems to have its propaganda mills cranking out garbage full blast, perhaps even straining the almost inexhaustable coffers of the assorted unscrupulous manufacturers who are dreaming of a $500 million a year market if they can just get that band away from the hams.

The EIA lobby in Washington is totally unopposed by any organized amateur radio effort to save the band since we have no Washington lobby of our own. The EIA seems to be encouraging the manufacturers with pie in the sky promises of great golden rewards . . . just imagine the profits if one out of every ten new cars sold (10 million cars) had a $200 CB transceiver! That's $200 million a year!!! Then one out of two of those would buy a base station too . . . and add in business use for doctors, plumbers, salesmen, farmers, etc., and you have $500 million a year . . . yum.

The EIA seems to have managed to get the Defense Department to okay the deal, leaving it squarely up to the FCC. The FCC could hardly be less enthusiastic – and no wonder – they are at wits end with the present citizens band and the prospect of unleashing a new screaming mess of CBers hobbying away with illegal calls, illegal power, illegal antennas, and illegal language gives them the whim-whams. Can the FCC withstand the one-way pressure?

Can anything be done to save this amateur band? Is it really worth any serious effort to save? After all, it is virtually unused today, so why make any big deal out of it?

It may come as a shock to low banders, but the most used amateur band today, by far, is the two meter band. Over one third of the active amateurs in the U.S. are on two meters! You can't say that about any other band. In many areas of the country the top half of two meters is virtually filled . . . and in the case of New York, overfilled. The congestion there is a harbinger of what is to come for the rest of the country in perhaps another year or so.

Where do we go next when two meters is full? We go to 220, that's where. What about 450? This band is a lot fuller right now than you think . . . what with television using the lower third of the band, weak signal ops using the center third and FM repeaters and control links using the top third. There is room for expansion on 450, but not a whole lot in urban centers. No, we need 220 . . . we need it now . . . and we will need it desperately in another couple of years unless FM growth suddenly stops . . . and there is no reason to expect anything but continued growth of FM since it is one of the biggest bunches of fun amateur radio has ever provided.

I am convinced that 220 MHz can be saved for amateurs . . . and saved in its entirety. I believe that we have the thinking part of the FCC on our side and that if we give them any reasonable excuse for saying no to the manufacturers that they will indeed say no.

Time is short . . . painfully short. If we dawdle for a few more months there will be no way to save the band. The way to save it is the obvious one . . . use it. Use it or lose it, a good slogan and an accurate one. So how can we use it . . . in a hurry?

The prospects of much more AM or sideband operation on 220 are not encouraging . . . but more FM would be simple and could be quickly organized. If every repeater group in the country made it a crash program to put on a 220 repeater . . . NOW . . . we could have somewhere between 500 and 1000 repeaters on 220 MHz by fall . . . and I think, if we could do that, we would have ourselves an amateur band and no great big CB mess.

This plan was unfolded before the representatives of about 50 northeastern repeaters at the Shrewsbury FM Symposium in February and every single two meter repeater group agreed to put on a 220 signal as quickly as possible. The first on were the WA1NXG repeaters in Connecticut, with both WA1KGQ in Vernon and WA1KHA in Torrington going on full 220 repeat in early March! Bruce and the group are to be congratulated!

The big holdup for large scale integration of 220 is obviously the lack of equipment. There is little available in quantity for the band. This is being corrected, thank heavens. Ed Clegg has announced that he will soon have a 220 transceiver available . . . plus a 220 repeater package. TPL, which sells through Henry Radio as Tempo, will be making deliveries of their long-awaited 220 transceiver ($179) and that should get things moving. This is an AM-FM rig, for both crystal and vfo use. TPL is also working on a 220 repeater package which is expected to be priced at about $300. Look for 220 gear from Avcom, Standard, SBE and others before long. By fall the rush to use 220 may be on in earnest . . . perhaps we can save this one. You may be sure that every piece of 220 gear that comes out will be reported in depth in 73.

Credit where it is due: the ARRL filed a comprehensive comment with the FCC supporting the amateur need for the 220 band and pointing out the reasons why CB use of the frequencies would be to the advantage of no one except a few manufacturers.

The future of 220 MHz is up to you. Members of repeater groups should raise cain until a 220 transmitter (at the least) is put on. Please be sure to let me know when you get on the air so your transmitter can be listed and the FCC can be advised of your use of the band.

What channels to use on this band? The northeastern repeater groups decided, after a lot of hassling, to run all

(continued on page 10)

W2NSD *continued from page 9*

repeater inputs starting at 221.98 and going down every 120 kHz for each succeeding channel. The outputs would be 3 MHz above that, starting down from 224.98 MHz. Narrow band, please. The coordinator for the northeastern part of the country for this band (and all the other FM bands) is Pierre Catala F2BO/W1, 180 Maple Street, Needham MA 02192. As soon as coordinators are available or known for other parts of the country I will pass along their addresses.

THE SON OF 160m

Amateurs of my vintage can remember with great warmth the old 160 meter band, back when it ran from 1800–2050 kHz for phone and was the very best band we had. It was great for local and relatively short distance contacts and it was nice and wide . . . for those days. The other two major phone bands were restricted to Class A amateurs and were each only 100 kHz wide, and were each just about permanently filled with a handful of smug kilowatt nets . . . it only took nine of them to fill up each band.

The FCC tells us that it should not be long before that dratted Loran is removed from 160 and the band can again be turned over to amateur use. It's about time . . . Loran has been bypassed technologically for quite some time and has just been hanging on and on and on.

Say . . . perhaps you'd better pass along a note to your favorite manufacturer and let him know that it might be prudent to add one more position on the band switch of future models . . . and calibration for 160m. This will be one hellova band when it gets going again. You wait and see.

ROLLING OFF A LOG

About 75% of the FCC complaints against amateur have to do with the keeping of logs. This has nothing to do with any directives from Washington, but seems more to represent initiative on the part of a few engineers in charge of FCC monitoring stations. One is inclined to wonder why these chaps are not spending their idle hours trying to stem the flow of obscenity and linears on 11 meters instead of harassing amateurs over a regulation that is of utterly no importance today. Other than the fact that logs have "always" been required, what possible reason is there for keeping them? Logging has been done away with for many services, yet just because it still stands on the books for amateurs some engineers are making life absolutely miserable for quite a number of amateurs.

SSTV SCENE

SSTV reminds one of the early days of SSB. Remember when there were only a few SSB'ers, and they gathered on specific frequencies? Remember when DX stations first started appearing on SSB; the "Quacking;" the "Different type" pileups? The resemblance between the start of SSB and the start of SSTV is phenomenal. If this is any indication of things to come, SSTV may grow to be as popular, or more popular than SSB. And why not? Commercial TV replaced radio to a large extent, did it not? Soon "just talking" to a guy will be a mode of the past. Each day more and more of us are getting to see, for the first time, the fellows we've been talking with in the past. And believe me, that's quite a surprise. As the XYL, WB4OEE, said the first time she saw W7ABW, "But that's not how he sounds like he would look." Indeed, very few people do sound like they look. It's just that you don't notice it if you meet them in person. Sound interesting? Right on! Maybe I've enticed you to at least investigate slow scan TV. Chances are you'll find it the most fascinating aspect of ham radio since the spark gap.

The 1972 slow scan contest activity appeared heavier than last year, and band conditions were very good. There should be some high scores this year. One couldn't help but notice the way EA8CI was picking off QSO's on 20 meters. And 15 meters was usually good for a few more countries. There was a definite trend this year to the use of white lettering on a black background for ID's that seemingly punched through QRM. And I never heard last year's winner, W9NTP, on at all. Don?

Recently while working one of the SSTV gang, the question of power and final tube life came up. I was quite surprised to find the other station was running around 600 watts average output on SSTV, while I was running 50 watts output, average, on SSTV. Our pictures were closed circuit both ways. He was also having trouble with short final tube life under these circumstances. While I watched, he reduced output down to 50 watts. His signal dropped from around 20 over 9 to about S9. The pictures were still perfect copy.

This brings to focus an important point newcomers may not know. The use of reduced power is proper in slow scan TV. Since the 1200 Hertz carrier is constant, the duty cycle is 100%, the same as leaving a constant carrier on the air. Modern rigs can withstand this punishment only a few seconds; thus cutting back power output is the logical answer. Granted, 50 watts may be an extreme on low power and 600 watts may be an extreme on high power, but I think you get the point. The least power necessary to maintain a solid copy QSO is usually much less than you suspect. Most of the old time SSTV'ers who have a KW linear run 150 to 200 watts on SSTV, and have found these conditions a happy medium between tube life, signal strength, and QRMing others. A little experimentation on your part will show you your best power for your rig. And remember, reduce output power by decreasing mike gain and camera or tape recorder output, not by loading the amplifier lighter or (gad) by dropping the linear and putting a super heavy load on the poor exciter. Remember – let the rig and linear loaf along!

It's good to see exotic DX and celebrities on slow scan. 9K2AM, 9Q5BG and others keep the boys hopping on 20, and Barry Goldwater, K7UGA/WA7UGA had some good pictures for the slow scan net (14.230 MHz, 1800 GMT, Saturdays) last Saturday. He was 20 over 9 here in Birmingham, Alabama. Now if we can get the boys to move the camera off Barry and show us around that fabulous station of his!

I hope I'm not letting the cat out of the bag, but – the plumbicon tube can be used directly on slow scan – no expensive fast scan and sampling techniques involved. The tubes are difficult to find (TV station pullouts are the only way) but once you've secured one – WOW! More info on this will be available later.

Some of the gang are getting quite a few countries on slow scan now. Who's the W8 with 40 plus countries? W4MS and VE7JA are in the high thirties – no telling how many W9NTP has – I'm still plodding in the mid-thirties. How about you? Drop me a card and tell me your SSTV total, and maybe a good off-the-air photo you'd like to show in this column. Or, tell us about your special SSTV project you've been working on. It will be quicker to send mail to me directly, rather than through the

73 would appreciate getting a copy of any correspondence you may have received from an FCC engineer regarding logs. Perhaps, by making the names of these chaps public we can discourage them from pursuing this vendetta against hams.

Mind you, we don't in any way condone illegal amateur operation . . . over power, stuff like that . . . but we do want to try and protect individual amateurs against harassment, from any source.

. . .Wayne

73 office. My address is: *Dave Ingram K4TWJ, Eastwood Village #50N, Rt. 11, Box 499, Birmingham, Alabama 35210.*

Here is a list of some active DX stations using SSTV, thanks to W8YEK, who worked them. Look for them:

CT1PG	IS1GF	VE6RM
DJ0CN	KH6DEH	VK5MF
EA4DT	KL7DRZ	VP9GR
EA8CI	KP4GN	W4MS
EL2CB	KX6DR	XE3DX
F6AXT	LA3SG	XW8AX
FG7XT	LU7AAG	YN3RBD
G5ZT	OK1GW	ZL1AOY
GW3DZJ	ON4DN	ZS3B
HA7LF	OZ4IP	ZS6UR
HB9IT	PAØLAM	4M2BC
HK7XI	PY2EEG	4X4VB
HR3HH	PZ1DA	GY5PB
I1LCF	SM4AMM	9K2AM
	SV1AB	9Q5BG

Following is a suggested signal reporting system for use on SSTV:

R–S–V

R = Voice readability 1 - 5
S = Signal strength 1 - 9
V = Video readability 1 - 5

V0 = Nothing decipherable
V1 = Occasional letters come through, difficult to copy
V2 = Call sign readable, pictures visible, if not identifiable
V3 = Good copy on some pictures, occasional complete pictures
V4 = Good copy most of the time, photos recognizable, some interference, multi-path fading etc.
V5 = Solid closed circuit pictures

That's it for now. See you on SSTV.

K4TWJ

Worked all Mass. Cities & Towns Contest, 0001 GMT June 11 to 0400 GMT June 15. This is a maximum of 100 hours. Exchange: Signal report, City (or Town), County, and State. Scoring: One point for each Massachusetts station worked regardless of band. Final score is the number of different Mass. stations times the number of different incorporated Mass. Cities & Towns worked. Operators may enter as single band or multi-band stations. A certificate will be issued to the winner in each State, Province, and Country in each class. In case of ties, the entry having worked the most Counties shall have the higher position. Entries must be received no later than July 31, 1972. Entries must show date and time of Mass. stations worked plus the "exchange" information. Submit entries to Warren Baker W1DFR, 66 Rexford St., Mattapan MA 02126.

6 METER

THE FIFTY MEGAHERTZ BAND

W4GDS, known to many for his daring exploits as ZF1RS during several previous VHF contests, is planning to go even further afield this year. Bob has already been issued the call VP5RS and if everything gels as expected he will be active from Cacios Island for several days around contest time. Cacios, in case you don't know, is one of a group of islands located approximately 500 miles southeast of Miami and 175 miles north of Port-Au-Prince. Tentative plans call for a beacon which would be operative even if the band isn't open. Details will be published as they become available. By the way, Bob, do you really think you can get United to stop there?

While on the subject of DXpeditions it might be well to mention that the people who undertake these trips for our pleasure do so at their own expense and often require (and always appreciate) an SASE. The same is true of Stateside operators who live in sparsely populated States. The burden of postage on hundreds of cards each year is too much to bear. You can make life easier for these people and insure receiving a QSL by doing this small courtesy.

The annual VHF Conference of the Central States VHF Society is scheduled for the weekend of August 18–19–20. Now is the time to start making plans to attend. The society net meets at 2130 CST on or about 3980 kHz on Sunday evenings. Give a listen – you will hear a great deal of interest to the VHF–UHF devotee.

The near complete silence has been broken! The evening of March 5th brought a rather extensive opening from 7 Land as far east as the third call area. Glen WA7FPO, could be heard working Missouri, Kansas, Oklahoma and Tennessee, among others. The 5's in Texas and Oklahoma also got their share working into Florida and most of the Midwest. A report was received to the effect that the border states had earlier in the day heard signals from Central and South America; however the report has not been confirmed as of this writing.

In building several dozen KW PEP linears of the type described in the July 1969 issue of 73, a number of changes were made which may be of interest to those planning a similar project. The chassis size was changed to 8 x 10 x 2½ in. in order to allow the same amplifier to fit either the Swan or Heath speaker cabinet. Components originally mounted on the side of the chassis were moved underneath maintaining the same relative position. Each screen is now fed through a separate No. 327 lamp and bypassed by a 13K, 10W resistor. The resistor biases the lamp on so that less screen current is required to blow, the bulb. It may be necessary to adjust values in the screen supply to compensate for the additional current. With this modification it is no longer necessary to change one tube at a time in order to determine which of the parallel pair is defective. The amplifier will run quieter if you tack the chimneys to the sockets with 3 or 4 dots of silicon rubber bathtub caulk. It stops the inevitable chattering.

WAØABI

HOT GEAR

Joseph A. Gibson K1TLP, 181 So. Orchard St., Wallingford CT 06492, reports the theft of a Standard SR-C806 FM Transceiver, S/n 009210; also 25 watt power booster. $50.00 reward for information leading to arrest.

Aerotone Model 6M 355LT, S/N 685064, Penn Central RR Police, Rm 1750, Grand Central Terminal, 15 Vanderbilt Ave, NY NY 10017.

Std. SRC-806M S/N 102703, Clem Mathias, 3134 Coronado Ave., Imperial Beach CA 92032.

Lafayette HA-410 S/N 10014, Ger. Macari WA2KDG. 29 Carriage Dr., Kings Park NY 11754.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli, SR46A, No.446100	WA1EMU	9/71
Reg., HR-2, No.04-03505	WA5BNM	11/71
Sonar, FM3601, No.1003	WB2ARM	11/71
Coll., 75A4, No.804	WØMGI	12/71
GE, Portable, No.1041218	K2AOQ	1/72
Coll., 75SE-B, No.15640	Col.St.U.	1/72
Coll, 2153, No.12000	Col.St.U.	1/72
Coll., 516F1,No.1640	Col.St.U.	1/72
Simp. Mod-A, No.35457	W2PWG	1/72
SBE SB-33 No.103906	WA5JGU	2/72
Heath HW22A No.907-1835	W1BDX	2/72
Nat'l HR050 No.280019	WA5DQF	2/72
Halli., SR160 No.416000-108039	K9YVA	2/72
Drake TR3 No.3858	WA9EYL	2/72
Coll., KWM2A No 13815	ARRL HQ M. Godwin	2/72
Coll., 312B4 No.59920		
Coll., 30L1 No. 40084		
Coll. MPL No. 44507		
Coll. MM1 (mob. mike)		
Misco minispkr.	Sgt. Hopkins Wilm. DE Police	2/72
Swan SW174 No. 416-5	WØAXT	2/72
Reg. HR2A No.04-05896	K4GBL	2/72
HR2A, No.04-6208	WBFXX/5	3/72
Heath SB102,No.132-128107	W.Singer Woodbridge VA 703,491-2257	3/72
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72

Microwaves

Go away, appliance operators! This column is written for those amateurs enterprising (and foolhardy) enough to populate the amateur bands 1 GHz (1000 MHz) and above. Believe me, there is darned little commercial amateur gear up here.

So, for those who have what it takes to venture into black magic land via this column, let's lay some ground rules for the care and reading of the new microwave bulletin board.

This column belongs to you, the experimenter and microwave communicator. Any topic you wish clarified, any product you want the world to know about, and especially any news you may have to share with your fellow microwavers – all it takes is a postcard. This column can't exist without inputs from *all* of you.

1 GHz (1000 MHz) will be considered the "normal" lower cutoff frequency of interest, but an occasional venture to 450 will be made.

Waveguide & Widgets (New Products)

Fairchild reportedly has a 25¢ computer diode oscillating in the Trapatt and Impatt modes. The diode is the FD-300, and several people report powers (pulsed Trapatt) of several *hundred* watts around 500 MHz. CW Impatt oscillations around 3 or 4 GHz (no power level given) with this device has also been noted. For more information, see February 1972 issue of IEEE – "Transactions on Microwave Theory and Techniques (MTT)."

Thinking about next Christmas for your least-liked friend? Give him some new 15 GHz (yes, that's right, 15,000 MHz) ARSENIC transistors. The arsenic doping allows emitter regions to have a 1 micron (1/1,000,000 meter) width. The arsenic also allows you to create a pretty spectacular whodunit. This is more completely described in *Microwave Journal* February 1972, or write to Fairchild Semiconductor, Palo Alto CA.

Above the noise

Pete W6DXJ, Carl WA6RGH and Jim WB6BHI, have claimed a new amateur S-band (2300 MHz) record. It seems Pete and Carl had the first amateur phased-array (one-way) contact; Carl and Jim had the first phased-array to phased-array (two-way) contact, all over a closed 100 meter course. More information on this is being prepared for publication.

Microwave mumbo-jumbo

You may have a question or two about frequency designations in the microwave region. This one is typical:

What is "S" band and why is it so named?

It started a long time ago when scientists were inventing radar. Radar, by the way, was classified "Top Secret" during WWII. Even the name radar was "TS." Naturally, the frequency used was secret also, and what is more secret than "X."

So they called the old radar band (10 GHz) X-band. After the war, when things loosened up a bit, they began experimenting (mostly amateur experimentation – at that time we had all bands 10 GHz and above) with other frequencies. The old radar terminology stuck, and they began naming other bands apparently at random.

Herewith a tabulation of the letter bands:

Letter	Frequency Band	Amateur Band
P	200–400 MHz	220–225
L	400–1500 MHz	420–450
		1215–1300
S	1.5–40 GHZ	2300–2450
	1500–4000	3500–3700
C	4.0–6.0 GHz	5.65–5.925
X	6–12 GHz	10.0–10.5
K	12–36 GHz	21–22
		All above 30
Q	36–46 GHz	All
V	46–56 GHz	All
W	56–100 GHz	All

Thus, to speak of amateur "S" band, either 2.3–2.45 GHz or 3.5–3.7 GHz is the band in question. To distinguish, the terms "High S" or "Low S" are used to determine a particular band.

Amateur High S = 3.5–3.7 GHz.
Amateur Low S = 2.3–2.45 GHz.

Jim Weir, WB6BHI

Military Affiliate Radio System

MARS is made up of licensed hams who are interested in military radio communications. Separate programs are operated by the three services, all using similar rules. Any licensed amateur, sixteen or older, who has a station capable of operating on the assigned MARS frequencies (usually just outside the regular ham bands) may apply to the service of his or her choice for MARS membership. To apply, simply write for a MARS application to one of the following:

ARMY: Room 1C475, The Pentagon, Washington DC 20315.

AIR FORCE: Bldg. H243, Tempo E, 4th & Adams Dr. NW, Washington DC 20333.

NAVY-MARINE CORPS: 5827 Columbia Pike, Bailey's Crossroads VA 22041.

"Okay," you say, "I know how to get into MARS, but why should I join and what do I do after I get in?" The answer is complex – first, you take your place with a growing number of active hams who are getting invaluable training in military communications – who serve as an immediately available auxiliary communications system for the Armed Forces in the event of an emergency – and who handle countless thousands of morale-building messages and phone patches for our servicemen overseas. As an active MARS member you will be eligible for certain surplus equipment – some so sophisticated as to be beyond the reach of the average ham, and you will be eligible for correspondence courses from the various Armed Forces Schools and Institutes – courses that will take you from the basics through space technology, and at no cost! This column is not to be construed as a sales pitch for MARS – just the facts. More on responsibilities and benefits in future MARS columns.

Welcome to new Chief MARS Army, Col.(Ret.) Robert B. Woodside A3ZLH, who is a long-time active MARS member and former Maryland State Director. Acting Chief Joseph Ziglinski A4DIN, will remain as Assistant. Congratulations to A3ECP, another long-time Maryland State MARS Director, who was awarded the Army's Oustanding Civilian Service Medal . . . First Army has a code proficiency program, 4001.5 kHz, on the second Sunday of each month at 6:30 PM EST.

The State of Virginia is covered completely with a 2 meter MARS network, and plans are underway to link the entire First Army Area from Maine to Virginia! Repeater inputs are on 148.01, out on 143.99 as in most Army installations. MARS members from other Army areas are welcome to use these facilities when in the First Army area, according to Command MARS Director Bob Sheridan, and the same policy has been placed in effect by Third Army MARS Director Hal Mulkey and Fifth Army MARS Director Roland Belk. Perhaps by the time you read this the Sixth Army will have joined in the "reciprocal trade treaty!" Meanwhile, if you are a MARS member traveling in a different Army area, don't hesitate to use the facilities – the worst thing that could happen is for someone to tell you you are not authorized for that area – something that happened to no less a personage than Acting Chief MARS Army A4DIN!

* * *

Director A3EGN reports the installation of Delaware's first Army MARS 2 meter repeater. A1W, Southern New England Army MARS Director announces their spring meeting will be held at Natick, Mass., on either the 13th, 20th or 27th of April – check

locally if you plan to attend. Their first repeater will be installed at Ridgefield soon. The first New Jersey Army MARS repeater is being installed, just in time for the spring membership meeting at Fort Dix, and the spring dinner-dance at Fort Monmouth (you thought MARS was all work, huh?). A2BVE reports that New York, New Jersey and Pennsylvania held a very successful combined emergency drill on 6 February.

* * *

Congratulations to Air Force MARS – they have *35 repeaters* working in their Northern Communications Area! This includes 6 in Pennsylvania, 5 in New York, others in DC, Virginia, Connecticut, Rhode Island, etc.

Armed Forces Day is Saturday, 20 May – the annual opportunity for hams to work crossband with MARS HQ stations WAR, AIR, NSS and NPG, using all modes. In addition there is a 25 wpm code proficiency test and a 60 wpm RTT test and all contacts are acknowledged by colorful one-time QSL cards. The activity starts at 10 AM EDT and runs until 1045 PM EDT. Frequencies are too numerous to mention here, but look for the HQ stations just outside either end of 80, 40, 20 and 15 – they will announce what frequencies they are monitoring.

The 15th Annual Third Army MARS Conference will be held at Fort McPherson, Georgia, near Atlanta, with over 600 members and guests, on 14 and 15 April. In addition to the writer's wife AL4ECK, other important personages will include Maj. Gen. George Pickett, Jr., A4DIN Acting Chief MARS Army and Roland Belk, Fifth Army MARS Director. You are invited to visit with us and watch the top brass hobnobbing with the parking lot attendants, doctors, farmers, etc.

Other meetings: Texas Army MARS 13 and 14 May, El Tropicana Motor Hotel, San Antonio – New Mexico State MARS 20 and 21 May in El Paso, Texas (Bet there's a story there!) – Missouri Army MARS was held 8 and 9 April – Louisiana 15 and 16 April – Wisconsin 22 and 23 April, Kansas 29 and 30 April – Arkansas on 6 and 7 May. Consult your local Director for detailed information.

WAR is NCS for a new nationwide training net on 6977.5 kHz, seven days per week, 8:30 AM EST until 10 PM EST. All Army MARS members are invited to check into this net when possible.

Harry Simpson A4SCF
P.O.Box 27015
Memphis TN 38127

If you are planning to visit Mexico and wish to operate from there, write for a permit to operate. Send to: Liga Mexicana Radio Experimentandores, AC Malinos, 51307 & 8, Mexico 19, D.F., Mexico. Do not contact the Mexican government directly. (Thanks to BCARA)

RYUKYU ISLANDS

The Ryukyu Islands will revert to the control of the Government of Japan effective 1501 GMT, 14 May 72 (001 hours, 15 May 72, Okinawa/Japan time).

Effective with reversion of the Ryukyu Islands to the Government of Japan, the amateur radio call sign prefix KR6 will no longer be authorized for use by U.S. Forces personnel stationed in the Ryukyu Islands. The call sign prefix KA6 has been authorized for these personnel effective with reversion.

In addition, third party traffic, phone patch/message, will no longer be authorized to or from the Ryukyu Islands as they will be under the administration of the Government of Japan which prohibits this type of traffic.

* * *

All cards for WB4FWV, WA7MEA, DL4EQ, PA9FJ, HS2JR, HS2ACA & YBØAAW should go to DK1RR.

* * *

As of 1500 hours GMT, 14 May 1972, the KR6 prefix will terminate and will be replaced by KA6.

* * *

The Okinawa Amateur Radio Club (OARC) will change its title to Okinawa Radio Club (ORC). QSL cards may be sent via the KA6 QSL Bureau, Okinawa Radio Club, Ft. Buckner, APO 96331, San Francisco, California. QSLs sent to this address are limited to members of the radio club. Prior to sending a QSL card, you should determine by asking whether you should send direct or via the bureau. Request has been submitted to ARRL for the Ryukyu Islands to remain a separate country for DX purposes. We have also been informed there will be no third party traffic either to or from KA6.

* * *

Countries that share reciprocal operating agreements with the U.S.: Argentina, Australia, Austria, Barbados, Belgium, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Finland, France (and possessions) Fed. Rep. Germany, Guatemala, Buyana, Honduras, India, Indonesia, Ireland, Israel, Jamaica, Kuwait, Luxembourg, Monaco, Netherlands (and possessions), New Zealand, Nicaragua, Norway, Panama, Paraguay, Peru, Portugal, Sierra Leone, Sweden, Switzerland, Trinidad & Tobago, UK (and possessions), Uruguay, and Venezuela.

* * *

Third Party Message Agreements: Argentina, Barbados (U.S. stations operating /8P), Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Greenland (XP calls only), Haiti, Honduras, Israel, Liberia, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela.

* * *

From MARCO Bulletin

In September of 1971, there was a change in Japanese law, permitting use of amateur stations by Americans; however, due to the complexity of the procedures, there have been almost no cases of this system being used. It is almost impossible for a foreigner to operate an amateur station in Japan. Thus the plan of letting foreigners use club stations was devised. If a foreigner is registered as a member of a club consisting mainly of Japanese, he can operate the amateur station. It's just that call signs cannot be issued to foreigners as individuals. A case in point: U.S. Ambassador to Japan, Armin H. "Hank" Meyer and Mr. Alfred C. Roussean, who was in Kyushu for a short stay, were aware of this. The call signs were W3ACE/JH1YDR and W1FJJ/JA6YAO respectively.

* * *

From MARCO Bulletin

SSTV DIRECTORY TO BE PUBLISHED

Robot Research Inc., is preparing a world-wide directory of active amateur radio slow scanners. A statement appears in their brochure calling for amateur radio operators who are active in the operation to file their names and call letters. In return they will send a free copy of the directory when the calls are in and compiled. Write to: *Robot Research, Inc., 7591 Convoy Ct., San Diego CA 92111.*

QSL INFORMATION

GM5AXO via S. G. Hawley, Box 265, U.S. Navsecgruact, FPO N.Y. 09518 or QSL to WA4UAZ. DX may QSL via RSGB.

9Y4EH, Robin Rampersad, 1402 Regent St., #672, Madison WI 53711 or via Rampersad, 51 Moody-Stuart St., San-Fernando, Trinidad Stobago W.I.

ou goons don't ever proofr
lousy
bunch of rocks
you ignored my
I insist that you print ev

LETTERS

"You have made my day!"
George K3QHY

In the mid 1930's we, W9PRH, W9STT and W9UJC, lived within a block of each other in Bismarck, North Dakota. As time we on each moved away and we lost track of one another. W9PRH eventually ended up in California. W9STT also was in California (Los Angeles). W9UJC moved to Billings, Montana. W9PRH let his call and license expire, W9STT became W6WKY, W9UJC became W7FKW. W6WKY and W7FKW established written communications and kept in touch by Christmas cards and notes over the years. In January 1970 W6WKY and W7FKW got together on the air and made a sked for the next day. During the QSO that followed we got to reminiscing about old times and friends and our travels. We were talking about ex-W9PRH and wondered what had happend to him.

Unknown to us was the fact that ex-W9PRH had moved to San Pedro, California, and had purchased a used receiver, had it on and was listening on the same same band and frequency and heard us talking about him. He got our addresses from a Call Book and wrote to us. We were amazed and surprised to hear from him. What a coincidence that he should hear us! As a result ex-W9PRH got re-interested in ham radio, boned up and got his ticket: WA6AYA. The three of us have had skeds on Sunday for some time. W6WKY and WA6AYA had an eyeball during the summer of 1971 and in Feburary 1972 the three of us had an eyeball at the home of W6WKY at his Los Angeles QTH. What are the odds on something like this happening?

M. Hansen W6WKY
Los Angeles CA

About 3 to 1.

Please put me on the 73 subscription list. $6 is enclosed. Keep up the emphasis on FM. Also please put me on the Repeater Bulletin mailing list. (I use K1FFK). I hope to work you soon through FFK. I'd like to see an article also, on a moderately priced homebrew or otherwise synthesizer.

I'd like to see an FM contest – maybe number of stations worked with a repeater multiplier and a multiplier for handy talkies. Some way, though, the repeater should be kept open for non-contest use. I disagree about shifting the National XCVE frequency from 94/94. We have two repeaters here that have 94 outputs (K2AE and WB2NNZ) plus direct activity as well and because of the capture effect things seem to work out fine. In fact there is an advantage as direct people can talk to many mobiles who are one channelers – either NNZ (34/94) or AE (46/94).

One more thing. I cast a yea vote for 10 meter repeater links. I'd also like to see a sideband link for 15. How about output on 21.445 to stay away from DXing and other non-repeater activities.

Jon Soffer WA2LXI
Albany NY

The consensus re FM contests is yeccch.

You talked about someone on two meter FM working DX through a link and I heard it today. Operating on 2 meter FM with 1 watt WB8AGZ/OE9 was working through OE9JKI/mobile OE9 to OE9AHI who was working on 25 meters to a W8 in Michigan. The copy was 100%, S9+ both ways. It was so good that I listened instead of getting the tape recorder on line to make a tape. The only thing that could have been better was for the WB8 to be on skis not in his warm-up boots.

Jim Kirkgasser WA2ELA
Dewitt NY

Looks like Austria's getting ahead of us.

ERRATA

In your Feb. 1972 73 Magazine I noticed an error in your "Tuning Mr. Morse's Key" article. The photos on pages 17 and 18 of holding the manual key and bug paddles have reversed captions. Check and you will see!

Peter E. Brown WA2PTW

That's not a bug paddle, it is a keyer paddle.

Morse Memory – Revisited

As a result of several letters and my own review of the Morse Memory (*73* December 1971), I have reviewed the article and the following corrections should be made:

1. In Fig. 1 an arrow is missing from the Memory Address to the Memory.

2. In Fig. 2. the Q output of A6 should be pin 6.

3. In Fig. 2 there should be switches shown from the four A1 gates.

4. In Fig. 2 the CS siwtches at the very top must have the unused terminal on each switch connected to +5.

5. There are a couple of discrepancies between Fig. 6 and Fig. 2. A7 (Fig.2) is not shown in Fig. 6. A7 (Fig. 6) is the 8 input NAND gate in Fig. 2. The 10K resistor in A5 (Fig. 6) should go to pin 9. Pin 13 of A3 (Fig. 6) should be DATA 1.

6. Now for Fig. 5: the –9 volt supply is obviously wrong. I built it with the bridge reversed and Q3 is PNP. Instead of the GE xstr for Q3 a 2N408 would be appropriate. Also T3 should be marked 12.6 volts.

I'm sorry for the inconvenience this caused the many people who wrote to me, and the many more who didn't. The Morse Memory does work. Good luck.

Hal, WA6ATT

How about more articles on 6 meter FM & SSB operation. 2m has been fully exploited. For heaven's sake, keep us posted on FCC rulings on FM repeater operation! Much needed around here!

Mike, K7LYK
Seattle WA

POPULATION GROWTH

The purpose of this letter is to set forth an idea for increasing the annual number of hams. It won't require any action by the FCC, but it will evidently require a change of spirit in many of us.

Actually it is quite simple. If, since the day you became a ham, you have not yet been directly responsible for at least one new face in our hobby, then promise yourself, make a resolution, that you are going to get at least one interested person into the hobby this year (perhaps sort of as passing along the help you got when you were starting). Give that person help with the understanding that he (or she) will do the same tning in a few years.

So far, it is evident that this has not been done. While there were something like 17,000 new amateurs last year, this figure would have been about 50% larger if just ONE-TENTH of us in the U.S. had made the above resolution. Perhaps the lack of people who like to train new hams is due to the fact that many of us haven't tried it yet, don't think we're qualified, or don't think we have the time. Well, if you haven't tried it, why not try? If you don't think you are qualified, how did you pass the exam? If you

can't spare about 45 minutes per week for a few weeks, are you dead or something? Actually, all I'm trying to say is that helping someone else into a hobby that you know is really great is one of the most rewarding things you can do in ham radio.

In case anyone wonders what I've done recently, I've graduated a total of 90 new hams from 3 classes in 3 years. Age here is 18.

Just try it once this year, and see what a great feeling you get when that guy shows you the QSL from his first QSO.

John Kittler WA9ZXU
Rock Island ILL

That's great, John. We should do everything we can to promote interest in ham radio. I recently received a letter from a young person who wanted to become a ham and asked the assistance of an old timer. The OT said he didn't have time. With an attitude like that, it's easy to see why so many kids get into CB. Ham radio has so much more to offer. Boy Scouts need merit badge advisors. High schools sometimes have hobby shows. Maybe your club can operate Field Day on the town common while a few members explain what is happening and why. There are hundreds of ways to involve others in ham radio. We owe it to each other to do it. Now.

KIND WORDS

I'm a Junior at ISU and have been away from 73 and ham radio for several years.

I'm happy to be getting back to both now. I just thought I'd take time out from studying for final exams to tell you how pleased I am with 73.

Mark Lund WAØRAO
Ames, Iowa

Hey, if you run into WØLR, who hates 73, say HI!

I just received my first issue of 73 which I can call my own and almost immediately got a friend of mine to subscribe. It sells itself and is much better for someone with QueSTions than another mag put out by someone else.

Seriously, I think that the idea for 2 meter repeaters is great, but the manager of this station, whose call letters I would rather not have printed, says that a tech signal may not be repeated into the upper class segments of the band. Would you please clarify this for me?

Name withheld by request

Once everyone has this clarified, repeater growth will sky-rocket. The apartment dweller without the ability to set up outdoor antennas will soon be able to be repeated around the world while he sits at home with a little ground plane hanging from the ceiling. Techs can be repeated into other bands under the correct licensing procedures.

I don't like the new look of 2 meters (FM, crystals, "CB like" etc.) and it was my only VHF operation about 3–4 years ago. Thank God 80m CW hasn't changed. I subscribe to no ham mags now. 73 will be the only one.

W. R. Meador WA8TRB
Niles Michigan

The fastest growing aspect of ham radio obviously has a bit to recommend it. Try it – you'll like it.

I like to read 73 and wouldn't miss an issue. I have been here in Texas two weeks and a few of us are putting up a repeater in nearby Wichita Falls with 34–94 facilities. It will be open, carrier operated, and a Touchtone autopatch planned. There is no call letter for it yet.

Don Fraser WA9WVS

34–94 repeater #543 being planned.

I have been slogging through mud and snow down to the local electronics store every month to buy your stupid rag since issue No. 1. The proprietor laughs in my face each time I pick my copy of 73 off the shelf and occasionally sics his dog on me as I leave. NO MORE! I refuse to be made a fool of. 'Tis time my mailman, a professional slogger, earned his keep by delivering that stupid, atrocious, unauthorized, irreverent, unofficial nothing you so flippantly call a magazine. Enclosed you will find my subscription. Hah! Now who's stupid?

Walter A. Miller WA9BUN
Park Ridge, Illinois

It's abooouuutt time.

I recently completed three terms as SCM of Georgia and am a loyal league member for nearly forty years. I have not always agreed with your views regarding the league, nor have I always been in sympathy with the attitude of the league. In fact my split feelings prompted me not to offer for reelection and to discontinue league activity although I remain a member in order to have the right to voice my opinions.

Howard L. Schonher W4RZL
Columbus, Georgia

The only one who agrees with Wayne all the time is Wayne, and even then . . .

Thanks for an excellent issue on CW. You can t be as one-sided as anti-FM'ers think you are, if CW made the front page. In all sincerity, 73 is still as different from the other three to keep me a subscriber.

W6GMD/7

CW and FM were just subterfuges. SSTV is the only way to go.

Got a huge charge out of our brief SSTV QSO this AM! It will certainly do no harm to SSTV to have one our our most outspoken editors "seen" regularly! (Won't hurt 73 a bit, either!)

You may not recall, but almost two years ago you forwarded my request for help to Ted Cohen W4VMF. Ted was extremely helpful, guiding me along the not-too-well-trodden trail to successful SSTV operation. I had built the K7YZZ scanner and had the very great pleasure of a 2-way QSO with Lou himself during my first attempts at pic transmission. Also worked Ted finally.

I am slowly converting to solid state and adding a Plumbicon camera. It is only through this activity that I have had the opportunity to learn anything about digital and linear IC's.

Please keep a ready supply of such info on hand for future articles, even if they may be somewhat redundant in basic topic.

Availability of IC's at low cost, including op-amps, balanced modulators, PLL's etc., are all resulting in a re-emergence of the true "ham," the experimenter, innovator, developer and TEACHER!

Lee Clough W5GQV
Waco TX

STUDY GUIDES

Allow me to congratulate you on helping me pass my Extra theory exam. The series you ran in 73 was most helpful and rather painless. I have had success with others using your General series, also.

Jefferson Junior High of Champaign has a ham radio club which was formed last spring. I am their sponsor and teach Math and Science there for seventh grade.

William B. Vokac K9WQY
Mansfield, IL

It's sure good the way you fellows get info in one place and in a form even one as nontechnical as I can "dig." Good? It's great!

Sara A. Thompson
Houston, TX

KUDOS & QUERY

This is just a short note to make several points. The first is I enjoyed the February 1972 issue more than any since I started reading 73 two years ago. The QRP projects are probably the best way to go for those who wish to put some zip back in their operating time and get into the home-brew game.

The second point is that I believe the manner in which you have organized your journal, monthly topics, is very useful. The ideas in one article reinforce those in another, which at the same time serves to generate new ideas and approaches to a subject.

And now my third point. Do you think you could prevail on the Tempo people to come out with some information on the new 2m AM/FM transceiver you discussed in an editorial in the fall and that was advertised in the November 1971 issue? I would like to know when they intend to market it

(continued on page 16)

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

SUPPORT ARHA – YOUR VOICE IN Washington – the "other" national ham organization. Get expanded privileges for Technicians and Novice phone. Box 123, Syracuse, N.Y. 13210.

2-METER FM INOUE IC-10, Brand New, 1 & 10 watts, solid state, 12 channel, w/Xtals, w/accessories $249.50. Bob Brunkow 206-747-8421, 15112 S.E. 44th, Bellevue, Washington 98006.

LETTERS CONT.

and would like more information on it. We still have a fair amount of AM 2m activity (in addition to the repeaters in the areas) in central Connecticut. Therefore it would be an ideal rig for this neck of the woods.

David J. Norden W1GDM

As information on the AM/FM rig becomes available we will pass it along in 73. It might be helpful to understand that the Tempo FM transceivers are made in Japan and marketed through Henry Radio. This apparently results in a slightly lower dealer markup for other dealers, with the result that the Tempo gear is not urged on customers as much as higher profit items, to the detriment of this fine equipment. The Tempo amplifiers are made in California using U.S. components by TPL Company and are marketed for hams through Henry Radio. This also holds for the recently announced 220 MHz AM/FM transceiver which should be coming off the assembly line in the latter part of April. The 146 MHz version of this unit probably will see the light of day along toward the fall or end of the year. If it looks as if it will break sooner you will find out about it first in 73. In the meanwhile there is the Comcraft 2m AM/FM rig, which is very nice and fun to use . . . if rather expensive.

RTTY ART

Regarding the article in the January issue, RTTY ART MADE EASY, in the contents you state "A new art form is born." At first I objected because RTTY "art" has been around for years. Then I had second thoughts regarding WA6PIR. I've copied him on amateur RTTY and, friend, your statement is entirely correct, a new art form *has* been born!! Don has taken it out of kindergarten and put it up with *real* art. I have some of Don's art that you didn't print and that also is really fantastic. Thanks for running the article.

"Bud" Reach WØFTD

FIGHT TVI with the R.S.O. Loss Pass Filter. See p115, March 1972, 73. Write for brochure. Taylor Communications Manufacturing Company, Box 126, Agincourt, Ontario, Canada.

STANDARD 826M, just like new, used only for review in 73. 12 channels, Mosfet receiver (hot!), 10 watts output. Sells for $340 new, first check for $295 takes it away. Make check to 73 Magazine, Peterborough NH 03458.

FOR SALE. Ross & White 1972 model FM transceiver with 12 channels and 3 frequency tone burst built in by the factory. Loudspeaker on front panel for best audio results. S-meter, hot front end, protected rf transistors, all crystals easily changed and trimmed, 0.1 1.0 and 10 watt output, mechanical filter for selectivity, 6 IC's in one of the most modern circuits yet produced. This transceiver sells for $405 with the 1800, 1950 and 2100 Hz tone burst. The first check for $350 will get this unit, brand new, used only for tests at 73 HQ. 73 Magazine, Peterborough NH 03458.

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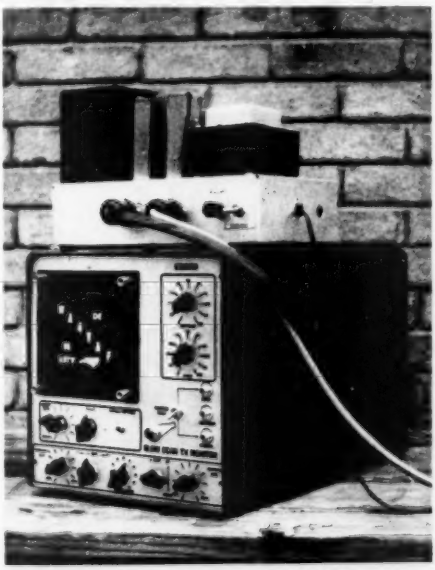
SSTV MONITOR THE EASY WAY

One afternoon about six months ago while tuning across the lower end of the 20 meter phone band, I came across some very odd sounding signals. They were musical like notes similar to Teletype, but it wasn't Teletype. I listened further and found it to be two stations transmitting slow scan television. One station commented he could see the cracks in the other fellow's teeth. That did it. I was hooked – I had to have one of those things. Well, right there was the catch. There wasn't a thing that was commercially built that I could just go out and buy. A few weeks later I did see an ad of Robot's in one of the ham magazines. The price came to about what I would expect to pay for a nice transceiver. No way to get that by the XYL.



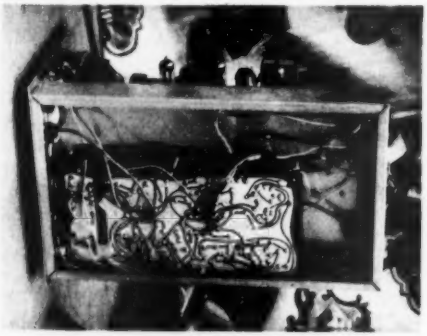
The completed monitor in store-bought cabinet. Outboard power supply on top. Panel was given a professional look by silk screening. Also note high-voltage wire enclosed in vinyl sheath for neatness.

In the meantime I had written to W4UMF[1] and sent along a self-addressed, stamped envelope, for a bibliography he had compiled. After going over the bibliography and locating most of the articles, and also discussing SSTV with the fellows on the SSTV net, I decided to build the Macdonald Monitor[2]. Along the way I noticed an ad in *73*. EKY Video Vision[3] had a kit of parts to build the monitor for a modest cost. One could also buy the two PC boards for a nominal fee and supply the parts himself. After looking over the parts list in the 1964 *QST* article and pricing them, I chose to order the complete kit. My junkbox was at

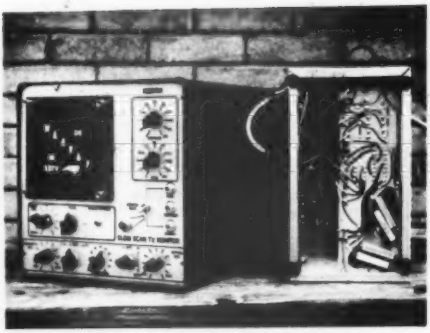
an all time low at this time, since I had made a move a couple of years before. New parts are high these days, but a fellow who has the time and patience plus a few good friends with well stocked junkboxes, can build this monitor for less than the cost of a lifetime subscription to *73*.

EKY was a little slow in getting the kit to me but that gave me some time to scrounge a 5ADP7 from a local surplus store, complete with mu metal shield for $5. I also ordered a cabinet and chassis from one of the popular mail order houses. I chose a cabinet that resembled EKY's in the ad. I wanted this project to have a good appearance since naturally I would have to be looking at it when it was in operation, and I dislike looking at a sleazy panel with controls and switches haphazardly protruding from it. I also wanted a professional lookng panel and wrote EKY for a drilling template, explaining what I wanted to do. EKY replied by asking me to mail my panel to them and they would silk screen it for me at no charge. This they did and in a few weeks I had a very good looking panel that only required drilling.

The kit arrived, and on inspection everything looked okay. There were a few parts that were substituted and these were noted in the boxes in which they were packed. Some of the small transformers would not exactly fit over the holes that were predrilled in the boards for them. It was no problem to drill additional holes to accommodate the new parts; after all a fellow with



Underside view of the monitor. Plenty of space for deflection board and power supply would fit if you really squeeze it together.



The completed monitor. Underside view of power supply shows EKY circuit board that makes for simple construction.

an Advanced ticket who plans to operate SSTV should be able to improvise some. Instructions do come with the kit and they are also supplied if you order the boards only. Don't expect the instructions to match the big time kit-makers; no "red wire soldered to lug B, etc." The boards are silk screened on the component side with the part numbers indicated. The boards make the job of assembling the monitor a real snap compared to what one would have to do with point-to-point wiring from the magazine article. Mounting of the shield, CRT and controls is left to the individual's preference. There are no instructions covering this since different chassis and cabinets may be used. There is mention of insulating the focus and brightness controls from the chassis or panel, since these controls have high voltage on them.

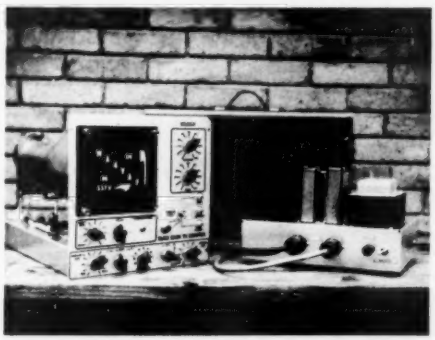
The picture on EKY's flyer shows the signal board mounted upright on the chassis next to the CRT. I chose to follow this layout as closely as possible since I had the same cabinet and chassis. The picture on the flyer does not show how the deflection board is mounted, but it is submounted under the chassis on standoffs. A large rectangular hole is cut in the top of the chassis to allow the tubes to protrude through.

About this time I decided to build the power supply outboard since it would be crowding things on the chassis, although it is possible to combine the two. Building the supply outboard is a must if the mu metal shield is not used. This works fine anyway

since you can also use the supply to power a flying spot scanner. I was looking ahead to this. I ordered the power supply PC board and components from EKY also as I could not locate too many of the parts. (They are not that hard to find if you are in no great hurry.) The PC board is a real life saver here also, and I would recommend obtaining it even if you do scrounge the other parts. Everything goes on the board easily and it makes the supply neat and compact. The supply itself is all solid state including a dc filament supply for all the tubes and a separate dc filament supply for the CRT.

I put the kit together over a period of several weeks, so all loose wires were labeled with masking tape as to where they should tie in or connect. No problems were encountered along the way. I used a nine pin socket and plug to connect the power supply to the monitor and a separate four pin socket and plug for the two high voltage leads. High voltage wire was used in these two leads and was run through a length of vinyi sheath for neatness.

Time for the smoke test. Apparently everything was wired correctly as nothing smoked or got hot. The instructions also include tuneup and operating procedure. Two TV horizontal width coils are tuned to 1200 Hertz and 2300 Hertz. The instructions call for an initial setting of the slugs and after tuning them with an audio signal generator they proved to be nearly correct. I suspect you could get away without tuning them with the signal generator as these two



The completed monitor with outboard power supply. Note the sub-mounted deflection board to the left and behind the panel. The cabinet which houses the monitor also has a neat carrying strap.

adjustments are not too critical. The trace on the CRT should appear in the lower right hand corner – mine was in the upper left. The instructions point out a possibility of this happening and the solution is to reverse the deflection plate leads. Having done this, the trace was where it should be. In getting ahead of the instructions I tried to center the trace on the face of the CRT. This was the wrong thing to do, as I found out after reading further along. An SSTV signal must be present to drive the sweeps and under no signal conditions the spot is kept off the face of the tube. This way you don't burn a hole in the phosphor of the tube when no signal is being received or have the tube covered with out-of-sync information during a weak signal period.

The only problem encountered was with the vertical sync adjustment. When a vertical sync pulse was heard the beam would not start a new raster. It took some fine adjusting but there was one best point where the pulse started the raster. Once this control is adjusted it need not be touched again. In fact, it is mounted on the deflection board and inside the cabinet, as is the horizontal sync control. The horizontal control setting is not at all critical.

I must admit I had quite a time adjusting all the controls on the front panel. A good tape of SSTV signals is a must and will make the job much easier. Trying to make the adjustments from signals off the air can be quite frustrating. A darkened room or shield around the CRT face makes for easier viewing. It took almost a whole day of playing with the different controls to become quite familiar with them. This is not to say it is hard to tune the monitor for SSTV, because it isn't. You do have to have a working knowledge of what each control will do and some experimenting and just getting the feel of the controls. Once the monitor is set up you need only touch the contrast and brightness controls, as you would a conventional TV set. Occasionally you may need to reset the sync control on the front panel to allow for variations in a transmitted signal.

So now you have a monitor and no flying spot scanner or camera to transmit. What can you do till then? A few sketches with

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ERRATUM

On page 22 in the April 1972 issue of 73, a curious and inexplicable error was allowed to occur. Two lines of type were neatly lopped off the bottoms of the two columns on that page, apparently by the mechanical process of reproducing the photograph, thus rendering the text incomprehensible. To date, exactly one of you out there has noticed this egregious error. . .for his benefit we herewith print in full the two paragraphs affected:

In order to assure sufficient flow some small holes should be left in the lower chassis. Leave the holes open in the corners of the chassis as *manufactured, but close up the hole in the* octal socket and at the filament transformer with putty or plastic tape.

Parts placement is not critical. Keep components in the lower compartment away from the grid coil which is supported by the tube socket on one end and the grid tuning capacitor on the other. The grid *choke is made in the same manner as the* plate choke, but with only 30 turns.

There. That's better, isn't it? The missing lines are, of course, those in italics above.

Monitor in operating position. A hood was added to the monitor for easier viewing and with it full room lighting may be left on.

CQ de your call, test patterns and also good quality photos of the shack sent to an active slow scanner with a small roll of recording tape usually brings back all one needs to transmit SSTV from your tape recorder through the mike jack of your SSB transmitter.

The next project here will be an FSS. Here again there are many ways to go, but after looking over the bibliography I think I will try the one from *73* July 1967[4], or possibly EKY's FSS kit. Why not, since the monitor turned out so well.

The first step is definitely the monitor though. I have received many SSTV pictures from hams in the states and also some DX stations and with S9 signals the monitor really does an excellent job. At times when signals are down in the noise, a picture containing contrasting call letters can be seen and read when you cannot hear the station's call on SSB. There are probably quicker and easier ways to get on SSTV, and probably even better circuits with IC's, but for the fellow who wants to get a monitor going with a minimum of fuss and know-how, for the money, the EKY board and/or kit seems to be the ideal way to go.

. . .WA4VAF

References

[1] T. J. Cohen, 6631 Wakefield Drive, Apt. 402, Alexandria VA 22307.

[2] Macdonald, C. *A Compact Slow-Scan TV Monitor, QST*, March 1964.

[3] Box 15, Stockholm NJ 07460.

[4] Hutton, L.I., *A Slow-Scan Television Picture Generator*, *73* October 1967.

Prepared by
Carl Martens
Applications Engineering
Motorola Semiconductor Products Inc.

A 40W 6-METER FM/CW MOBILE TRANSMITTER

This report describes a three-transistor transmitter capable of providing 40W continuous power output at 50 MHz in operation from a 12.5V supply.

The transmitter described in this article is designed for CW or FM operation; it is not suitable for AM operation at a 40W carrier level since this would require peak power voltage capabilities exceeding the rating of the 2N5849 final stage transistor.

A signal source providing 20 mW at 50 MHz is required for the transmitter. Provisions for keying or frequency modulation are not described, but such features can easily be added to fulfill the requirements for a specific application.

A schematic of the transmitter is shown in Fig. 1, and the performance data appears in Table I.

The first step in designing this power amplifier is determining the required number of stages and the necessary gain per stage. A block diagram as shown in Fig. 2 is helpful in this estimate. The desired output power is 40W into 50Ω. According to the data sheet, the 2N5849 transistor can provide 40W from an input power of 6W. If a 1W allowance is made for circuit losses, the required drive for the final stage becomes 7W. The 2N5847 is rated at a power output of 7W for an input of 0.5W,

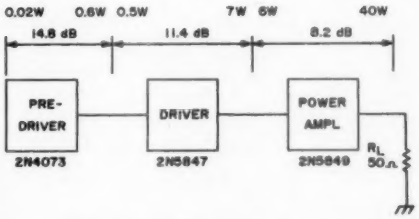

Fig. 2. Transmitter block diagram.

and the 2N4073 has sufficient gain to provide about 0.6W from 20 mW. This completes the block diagram and the basic specifications for the individual stages.

Circuit Description

The basic requirement of high power with good efficiency suggests a class C amplifier design, and the common-emitter

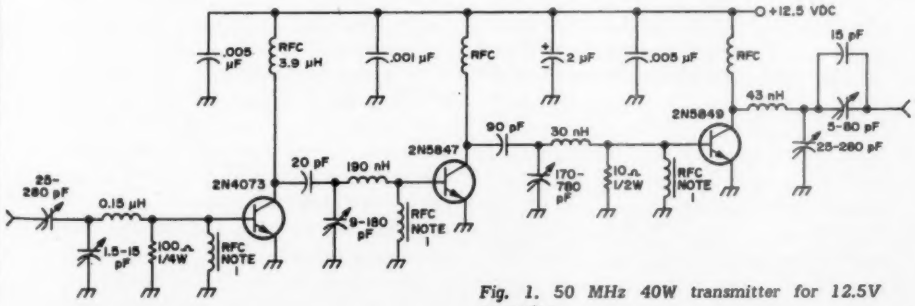

Fig. 1. 50 MHz 40W transmitter for 12.5V operation.

Table I. Transmitter Performance Data

Power Output	40W
Power Input	20 mW
Supply Voltage	12.5V dc
Total Current Drain	5.4A
Overall Efficiency	59.2%
Second Harmonic Output	25 dB down
Third Harmonic Output	45 dB down
Final Stage Current	4.7A
Driver Stage Current	0.65A
Predriver Stage Current	50 mA

configuration is selected for high power gain.

Final Stage Design. At the operating conditions applicable to the present design problem, the large-signal impedance data for the 2N5849 transistor have the values shown in Table II.

Table II. Parallel Equivalent Large-Signal Parameters — 2N5849

V_{CC} = 12.5V; f = 50 MHz; P_{out} = 40W		
R_{in}	0.8	Ohms
C_{in}	500	pF
C_{out}	625	pF
C_{out}		

The resistive portion of the collector load impedance, R_L, may be calculated (assuming a peak-to-peak collector-voltage swing of 2 V_{CC}) by using the expression:

$$R_L = \frac{V_{CC}^2}{2P_O}$$

where P_O = rf power output and V_{CC} = dc collector supply voltage.

For the 2N5849 the collector load is:

$$R_L = \frac{(12.5)^2}{2 \times 40} = 1.95\Omega$$

As the load impedance is small compared to the 50Ω termination impedance, the network configuration shown in Fig. 3 is well suited for the final stage. The values of the network components may be found directly from the tables in Ref. 1. Several combinations are possible for the network components, depending on the value for Q_L, the loaded or operating Q. A loaded Q of 10 provides convenient component values, good harmonic attenuation and smooth tuning.

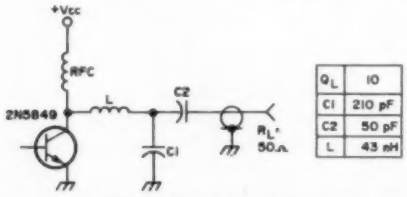

Fig. 3. Output network

The driver/final interstage network must match the input impedance of the 2N5849 to the required collector load impedance of the 2N5847, which at the required drive power level of 7W is 11.2Ω in parallel with 160 pF. Reference 2 outlines a method for obtaining large-signal transistor impedance data.

Again a tee configuration is selected, and the circuit parameters are shown in Fig. 4. Proper biasing of the final stage is obtained by connecting an rf choke from base to ground. The selection of this choke is somewhat empirical, but as a rule its inductance should be kept as low as possible, and it should be a low-Q type to avoid possible resonance with the base–emitter junction capacitance. Ferrite-bead chokes are well suited for this application.

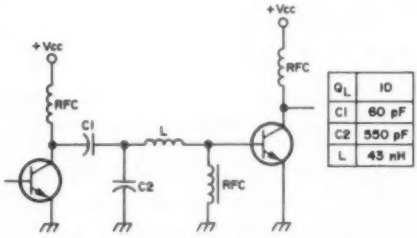

Fig. 4. Driver/final interstage component values.

It is also important that the resistance of the collector choke be as low as possible. In rf power stages, collector currents are often several amperes in magnitude: therefore, resistances as little as 0.1Ω can cause significant power loss.

Driver Stage Design. The tuned network must match the output impedance of the predriver stage to the input impedance of the 2N5847 driver stage. A tee network is

chosen, and the computed circuit parameters appear from Fig. 5. Biasing of the driver stage is accomplished in a similar fashion as for the final stage.

Predriver Stage Design. All that is required to complete the design of this stage is determining an input network providing an impedance match between the input impedance of the 2N4073 transistor and the 50 + j0Ω generator impedance.

Following the procedure outlined in Rf. 1, the network shown in Fig. 6 may be calculated. Component values are shown in the figure.

Thermal Considerations

From the performance data listed in Table I, the power dissipated in each stage, P_D, may be calculated using the expression:

$$P_D = P_{in(RF)} + P_{in(DC)} - P_{out(RF)} \quad (2)$$

Solving Eq. (2) for each stage in the transmitter yields:

Predriver: 45 mW
Driver: 1.625W
Final: 24.75W

A heatsink for the output transistor may be evaluated from the expression:

$$\theta_{SA} = \frac{T_J - T_A}{P_D} \quad \theta_{JS} \quad (3)$$

where T_J = maximum junction temperature,

T_A = ambient temperature, and

θ_{JS} = junction-to-heatsink thermal resistance.

Furthermore:

$$\theta_{JS} = \theta_{JC} + \theta_{CS} \quad (4)$$

where θ_{JC} = junction-to-case thermal resistance

θ_{CS} = case-to-heatsink thermal resistance.

For the 2N5849 transistor, the following thermal data apply:

$T_J = 200^\circ C$

$\theta_{JC} = 1.75^\circ C/W$

$\theta_{CS} = 0.25^\circ C/W$ (Using a thermal compound and mounting nut torqued at 8 in.-lb)

Substituting the 2N5849 data in Eq. (3)

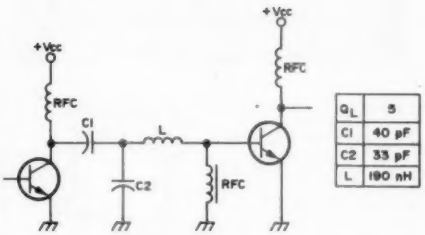

Fig. 5. Predriver/driver interstage component values.

for a worst-case ambient temperature of 60°C yields:

$$\theta_{SA} = \frac{200\text{-}60}{24.75} - (1.75 + 0.25) = 3.65^\circ C/W$$

If operation at an ambient temperature higher than +60°C is desired, the device dissipation-derating information on the transistor data sheet and Eq. (3) and (4) may be used to complete the heatsink design for all three stages.

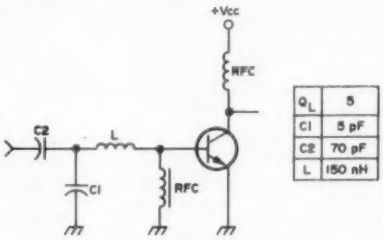

Fig. 6. Input network.

Construction

In the construction of the transmitter, the usual precautions normally taken in rf work must be observed. The selection of ground points is particularly important. The chassis current path between the base-choke grounding points and the emitter grounding points must be kept very short to reduce inductance. Variable capacitors are used in the tuned circuits to facilitate adjustment of network loading and tuning. A fixed capacitor is used in parallel with the output-stage series capacitor to provide protection against complete decoupling of the load.

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All base chokes in this construction are low-Q types from the VK-200 series manufactured by the Ferroxcube Corporation of America. The 100Ω resistor in parallel with the predriver base choke and the 10Ω resistor in parallel with the final-stage base choke were incorporated to insure circuit stability for a wide range of drive levels.

It appears from the complete schematic of Fig. 1 that the fixed capacitors in the two interstage coupling networks are different from the calculated values. This is due to the fact that the type of capacitors used, phenolic-encapsulated silver micas, were found to differ from their nominal values at 50 MHz. The correct values of 40 pF and 60 pF were determined by measuring a number of capacitors.

References

1. Davis, F., "Matching Network Designs With Computer Solutions." Application Note AN-267, Motorola Semiconductor Products, Inc.
2. Hejhall, R. C., "Systemizing RF Power Amplifier Design." Application Note AN-282, Motorola Semiconductor Products, Inc.

. . .Martens

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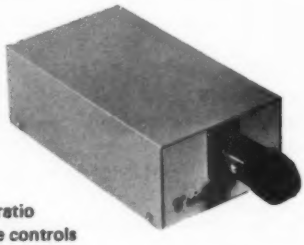

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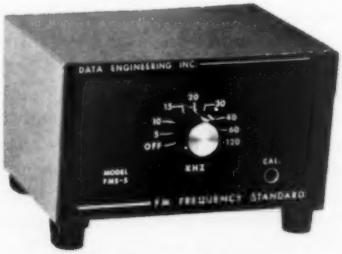

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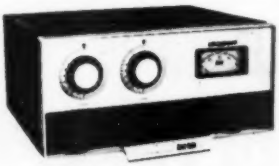

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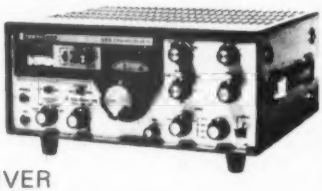

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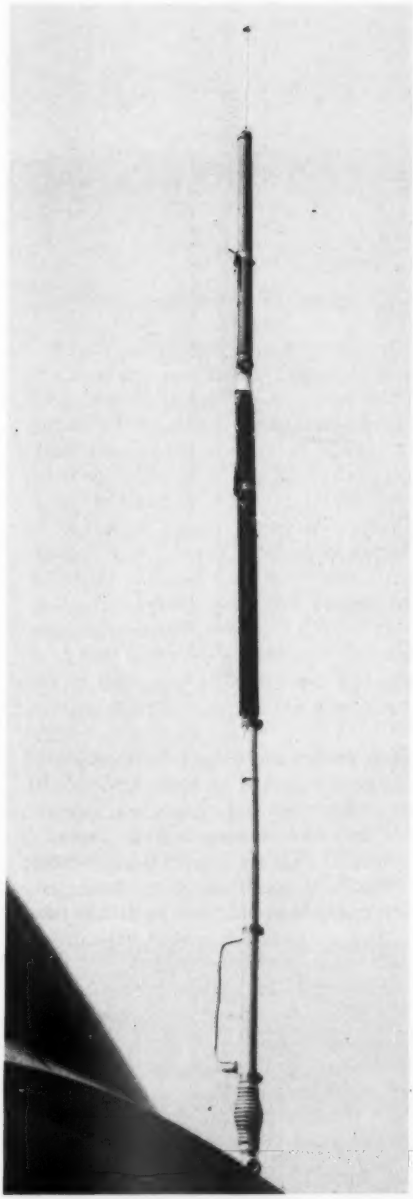
QUICK BAND-CHANGE MOBILE ANTENNA

All antenna systems represent a compromise. One of the greatest is that of squeezing a 3 MHz quarter-wave onto the back of an automobile.

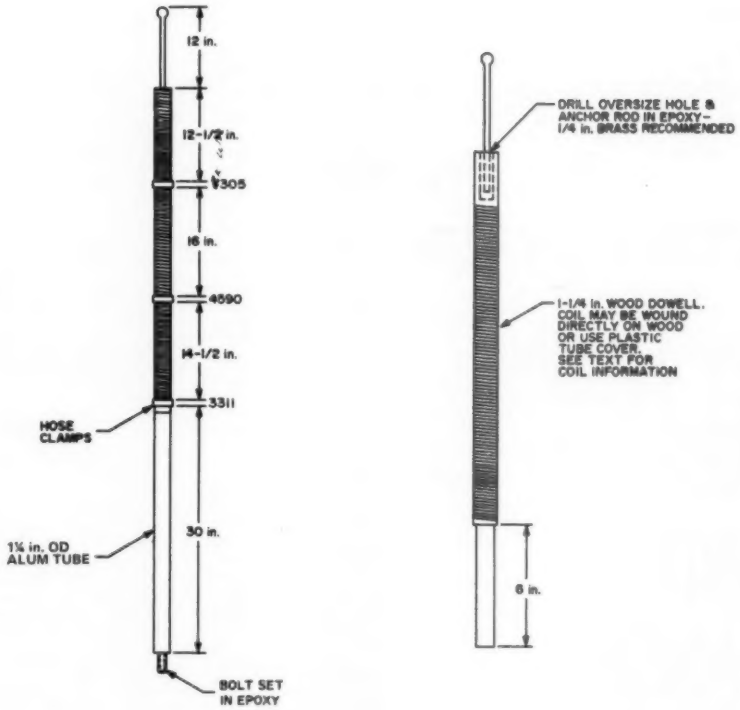
A look at the price tag affixed to commercial antennas should provide you (as it did me) with a strong incentive for "brewing your own."

And price, while a major factor, may not be the only consideration. For example, I needed a positive, quick-change antenna, to hit Air Force MARS frequencies. Namely, 7305, 4590, and 3311 kHz.

The antenna shown in the picture is the result of four brewing ventures. Prototype



Antenna installed on 67 Chev. Used with Motorola SB3 Rig.
The coil is wound in two sections. Would be equally successful if wound in one section. Past models have been made in one section. Shorting bars in place for 40 meters. Two sections used here because of available coil forms.


12 in.
12-1/2 in.
4305
16 in.
4590
14-1/2 in.
3311
HOSE CLAMPS
1¼ in. OD ALUM TUBE
30 in.
BOLT SET IN EPOXY
DRILL OVERSIZE HOLE & ANCHOR ROD IN EPOXY— 1/4 in. BRASS RECOMMENDED
1-1/4 in. WOOD DOWELL. COIL MAY BE WOUND DIRECTLY ON WOOD OR USE PLASTIC TUBE COVER. SEE TEXT FOR COIL INFORMATION
6 in.

1 was temporary, being wound on a bamboo fishing pole. Taps were brought out, with many trials and more errors; however, this temporary antenna worked so well it literally stayed on the car until the base "rotted" off. Had I coated the fishing pole with epoxy, I would probably still be using it. This antenna was wound with plastic-coated 20-gage stranded wire.

At the demise of the bamboo pole, I decided to be smart and refer to the handbook. I read and studied, and ended up with a very nice looking "outer-space" antenna, with a big-wire coil in the center. The transmitter loaded. The receiver worked swell. Only one small problem: Nobody could hear me.

Maybe it wasn't quite that bad. But the signal was down many dB. The center-loaded antenna did not deliver the signal that the top-loaded fishing pole punched out.

So I set to work to rebuild a better looking and more rugged "fishing pole."

The antenna now in use has two coils, each 2 ft long. The only reason for using two coils is that by loosening a clamp, the top section of the antenna may be easily removed. Also, it requires a long coil to hit 3311 kHz, and the necessary forms may be available in shorter length. Whether the coils are wound in one or two sections makes no difference in the operation or tuning of the antenna.

Also, a shorter coil length may be used if only higher frequencies are to be covered. For 40–10m, a coil about 14 in. long is required. (Increase base length to 60 in.) For 75–10m, approximately 3 ft is needed.

Actual construction and tuning of the antenna is easy. No special tools or equipment is necessary.

The base section of the antenna is a piece of aluminum tubing 30 in. long. The bolt, with threads to match a heavy duty spring mount, is securely anchored in the base with epoxy. Three sheet-metal screws,

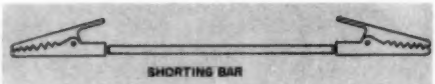


Fig. 1.

with the tips filed so that each barely touches the bolt, are useful in two ways. Helping to center the bolt, and keeping the epoxy plug from turning in the tubing after hardening, braid is soldered to the bolt and brought out through a small hole in the tubing. The braid is later clamped to the antenna with a hose clamp which reinforces the base and holds the 47 dial light indicator socket. Wadding keeps the epoxy where needed. Be careful. The bolt must be straight when the epoxy is poured.

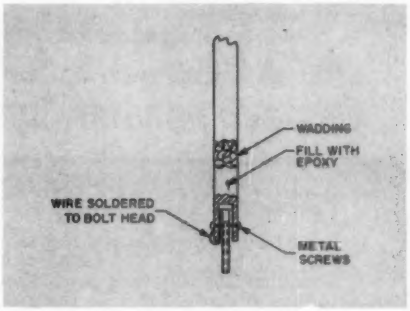
One satisfactory way I have found for winding the coil is directly over a wood dowel. If you have access to a lathe the dowel should be grooved to space the wire about one diameter. Or you may wind a string or another wire between turns, which may be later removed. (The coil should never be closewound, unless plastic insulated wire is used. The plastic provides the spacing.)

At least 6 in. of the wood dowel should be sanded, whittled, or turned down to fit snugly into the aluminum tubing base. Slot the top of the tube 1 in. A hose clamp will hold the coil in place and provide a terminal for the wire.

The tip section of the antenna may be any conductor. However, since this tip will receive some hard bumps, I recommend a section of ¼ in. brass rod. Solder a wire to the rod. A 5/8 in. hole is drilled in the end of the wood dowel coil form. Wire and rod are anchored in the dowel with epoxy.

After the coil is wound and tip fitted, cover it with a good coat of resin to securely fasten the wire in place.

Another method of winding the coil is to use a piece of 1¼ in. plastic pipe or other coil form and slip this over the wood dowel, which may be an old broomhandle with a layer of tape applied. Fasten the ends of the plastic to the dowel with screws. Dowel should be long enough to extend 6 in. down into base. Tip is attached as previously outlined.



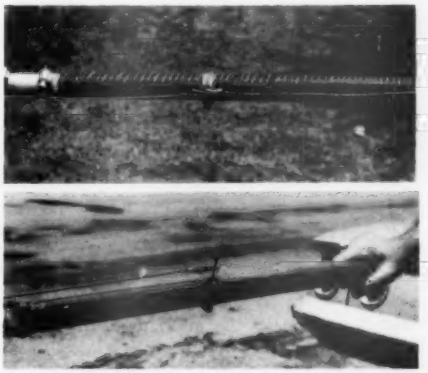
Or the plastic tube may be "splinted" to the base and temporarily "outside taped." Then the coil form and 6 in. of the base are filled with epoxy. The tip is placed in position and the whole thing hardens. This method is especially useful for the short coils, 40m and up.

A 36 in. plastic tubing form may be bought at a sporting goods store for about a dime. Just ask for the plastic covers designed to keep golf club handles from being scratched in the bag.

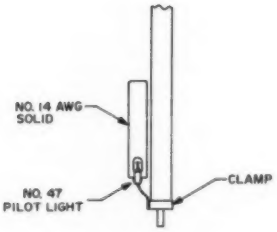
I have used coils constructed all of these ways. Using the wood is easier and works equally well. In any case the wire must be cemented in place.

After the coil is dry and both ends of the coil attached electrically to the base and tip, you are ready to start the tuneup.

For each frequency to be covered you will need a slider. Each slider is made of one hose clamp and one 6-32 brass bolt and nut. File the bolt head slightly flat.



Closeup of slider tap and shorting bar connections.



Indicator.

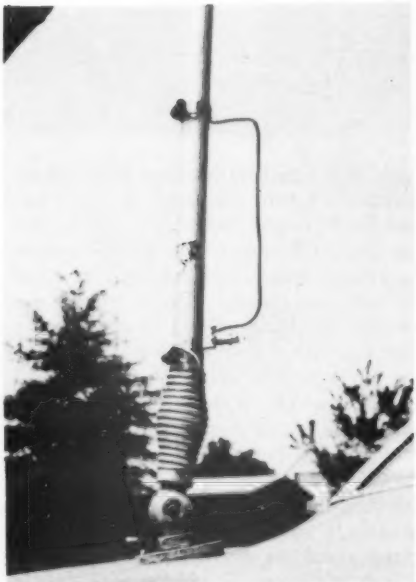
Drill a hole through the hose clamp. Insert the bolt from inside the clamp, securing with the nut. The bolt head will make contact with the wire coil.

By using the approximate measurements shown, estimate about where the tap should be for the frequency you wish to hit. With a coarse file cut through the resin and any insulation on the wire for 4 in. Your coil at this point will resemble a 100W slider resistor.

Now install the antenna on the car and place the receiver in operation. Work on the highest frequency first. For example I tuned 7305 kHz first. Then 4590, and finally 3311 kHz.

Attach a wire to the top of the base section long enough to reach the top contact area of the coil. Run the wire back and forth over the contact area. You will hear the receiver background noise peak sharply. If it fails to peak, but gets louder in one direction you may have to file some more. At the point where the receiver peaks, the antenna will take a load, but will probably require a bit closer adjustment.

Next install your output indicator, a 47 light bulb. I leave this indicator in place at all times. It provides positive "on the air" indication, not to mention what happens at night when a car pulls up behind and sees the sideband modulation waving in the air. The indicator is a loop of wire about 16 in. long, with one side of the loop taped to the antenna at the base and the 47 bulb in series with the outside of the loop. If it is desired to leave it permanently in the circuit it may be tapped across about 8 in. of the base using the antenna itself as one side of the bulb loop.



The 47 dial light output indicator. This light bulb shows at all times positive indication of on-the-air and is all you need to tune and load the transmitter. The loop in this instance is completed by the antenna itself. Can also be used as a complete loop taped to the antenna.

Using the bulb as an indicator, finish tuning until the desired loading is obtained.

Repeat the tuning procedure for each lower frequency desired. Then permanent shorting bars should be made. Brass welding rod and alligator clips are ideal.

Changing frequency is simply a matter of removing, or using the proper shorting bars. If several frequencies close together are required, several taps can be brought out every turn or every two turns, and a braid with attached alligator clip may be used to short out the unused portion.

This antenna has delivered plus performance. And when it comes to changing bands, it can be done in less than 30 seconds without hurrying, and this includes getting out of the car and back in. Every time the antenna will be in perfect resonance.

I scrounged everything. But if you have to lay out the cash, $5 should suffice.

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A Hi-Fi IC For Amateur Modulators And Receiver Audio

This is an introduction to the Amperex TAA300 Integrated Circuit af amplifier, a winner! When I say another winner I mean of course that it is Amperex who has the winner, because this little gem comes ready made for you in one of those little ten pin cans less than 3/8 in. OD. I should say nearly all as there is a collection of *external* accessories, some of which are much bigger than the IC itself. You can obtain these items in a much reduced size to match the IC, for a price, but we are concerned here with the Amperex TAA-300 IC af amplifier using readily available and amateur-priced parts.

Features of this device include high sensitivity, low cross-over distortion, low harmonic distortion, and high efficiency. And, I might add, a great sound!

See Fig. 1, internal diagram, and Fig. 2, the total circuit. This is one of those jobs using 11 transistors and four diodes when you might expect at the most, five active devices. However, any questions in my

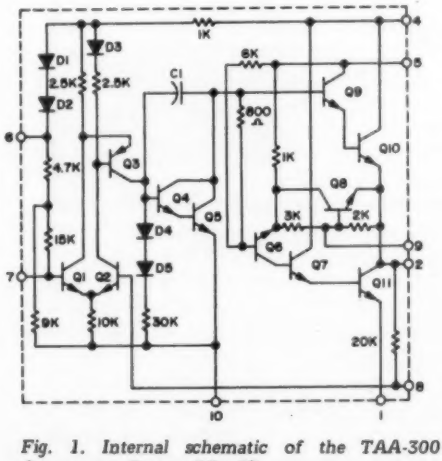

Fig. 1. Internal schematic of the TAA-300 Amperex audio amplifier IC.

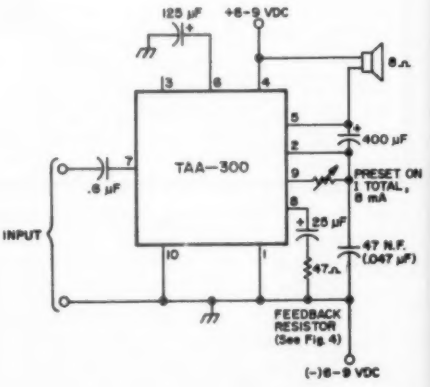

Fig. 2. External schematic of a complete audio amplifier using the TAA-300 IC.

mind were immediately dispelled as I listened to it with my favorite mike and hi-fi padded earphones. It actually sounded better and clearer than any af amplifier I have heard in a long time, with plenty of lows and highs evident, and lots of power and gain too. Every one of those eleven transistors inside that tiny package are certainly doing their stuff in the proper fashion.

Special measures have been used to prevent cross-over distortion with a supply voltage ranging from 4.5 to 10V, dc. There is a "bias set" resistor running between pins 2 and 9 which serves to set the current to a rated 8 mA total on no signal (see details in the external schematics, Fig. 2). When this resistor is varied and the total current drops much below 8 mils you can hear the cross-over distortion begin on low volume signals such as whispering in the mike. When set at 8 mils, even the lowest volume signals are clear and free from distortion. The large amount of negative feedback also helps reduce distortion to a minimum. At a power output of 1W, which is the TAA300's rating with heatsink, into

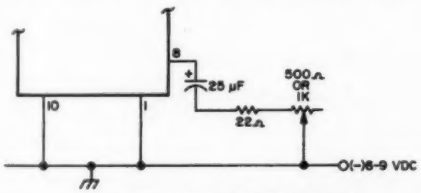

Fig. 3. Variable feedback control.

an 8Ω load, it still sounds great. The bandwidth at the 3 dB points goes from 30 Hz to 25 kHz, so, even though this sounds fine on a receiver, be sure and *reduce* that bandwidth when using it as a modulator.

At a power output of 1W the total current on the battery goes up to 180 mils, just like one of those regular old tube modulators you used to use. Of course the voltage is only ten so we're not talking about 180W, just 1.8W, which is still fine for portable all-solid-state rigs. The rated efficiency is 60%, which in my opinion is excellent for a good quality audio amplifier.

The input impedance is close to 10K and with my favorite mike, the Astatic

150, full output is obtained with the mike over a foot away. The reasons why the 150 is my favorite are: the price at $3.82, and the output of minus 44 dB which is the highest I know of. With no signal into the TAA-300 the noise can be heard in the earphones, but it is unlikely you would ever use that much gain. For all ordinary usage the amplifier is perfectly quiet.

The Variable Feedback Control

This feature certainly deserves a section of its own. Figure 3 shows the details. There is a 20K resistor carrying negative feedback from the midpoint of the output transistors Q20 and Q11, back to the base of Q2. This feedback line is bypassed to ground through a 25 mF capacitor. However, there is a resistor in series with this capacitor which in the external circuit diagram is specified as 47Ω. The amplifier works fine with that value, but wait until you try it with a variable 500Ω pot in its place! With the resistor value at zero, there is *no* feedback and the gain is terrific. With

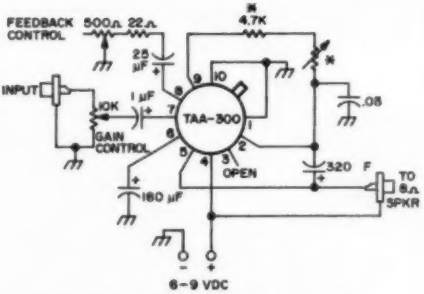

Fig. 4. Breadboard test setup for determining best values. Slightly different values are used here from Fig. 2. Read the application notes carefully for a list of the precautions to be observed while experimenting with this IC. Pin ten is also the case and can thus be grounded with a heat sink. A gain control is now always needed and may be replaced by a feedback control in some applications.

the pot wide open there is a lot of negative feedback and the gain is way down, but so is the distortion. Using the system as a gain control you are operating at all times with the least distortion and noise, and the feedback is at a maximum, which is good.

There may be a reason for not using this type of gain control, but since it sounds great I'm going to keep it in, particularly in modulator use.

Be *sure* and read the application notes if you are going to build. To prevent high-frequency instability, the following precautions must be taken: Keep the lead inductance from the positive supply voltage to pin 4 to a minimum. To counteract the high internal resistance of batteries, especially toward end of life, a 200 mF capacitor should be connected between 4 and ground. A capacitor of at least .05 should be connected between pin 2 and ground to prevent instability of the lower Darlington output transistor.

Avoid coupling between output and input leads, especially those carrying signals from a high-impedance source. This coupling can be reduced by using short leads, shielded input cable, or by limiting the upper frequency to 15 kHz by means of a 560 pF capacitor between pin 7 and ground.

The input lead and components will pick up lots of hum as a result of that excellent low frequency response if you do not take care with shielding. If you don't want all those lows, use a much smaller input capacity, especially for voice communication.

Layout

The layout I used for test purposes is shown in Fig. 4, although I imagine this can be packaged much smaller. The bulky items are the electrolytics, but once again Lafayette can help you reduce this size somewhat. I'll give just one example to illustrate. The 30 mF at 15V is only 5/16 by 7/8 in. long and costs only 23¢, if you buy 5 of them. Be sure and observe the polarity!

I used a 10K pot at the input, but with that fancy variable feedback bit you may not need it.

Be sure and follow the application notes, particularly the one about the lower Darlington output transistor. An input and output jack, a red and black battery lead, and you're on the air.

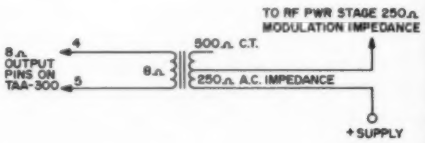

Fig. 5. Matching the output of the TAA-300 as a low power modulator using a small output transformer connected backwards.

From the way this little diamond sounds you'll be meeting it again and again in modulators and receivers. I suspect it will be very useful along with a "turned-around" output transformer, with the 8Ω side connected to the TAA-300 output and the other side, whose impedance should match the modulating impedance of your rf output power stage, in the 50 to 500Ω range. It should be connected with the secondary carrying the modulated dc to the rf stage, as shown in Fig. 5.

For receiver work just use an 8Ω speaker, period.

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Which is why Don Wallace hasn't been listening to anyone else lately. Not that he's choosy about who he listens to. Just whose equipment he listens on.

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73 TESTS and USES

The Larsen 5/8 Wave Antenna

After a few months of FM'ing, talking with FM'ers, and seeing two meter mobiles by the gross, the eye gets used to seeing a disproportionate number of the Larsen antennas on cars. They stand out immediately to the eye of the FM amateur for the simple reason that they are probably the most inconspicuous two meter antenna there is.

Larsen came into the ham market via the two-way commercial field, as did repeater two meter operation. Naturally these old time two-way men brought along the antennas that they had found to work the best and give the least trouble . . . Larsen.

That little antenna coil on the bottom of the antenna will handle 100 watts, which today is about the practical limit for FM operation. The coil is needed to tune the antenna since it is not resonant at the 5/8 wavelength mode and a good deal of high efficiency inductance is needed to get the swr down to where the transistor rigs won't balk. The Larsen irons out the problem to an insignificant 1.2:1 swr or better.

Larsen goes that extra mile in efficiency by silver plating their whip. We all know that silver is a better conductor of radio waves than copper or chrome (remember those silver plated coils in the better rigs?), so silver is an obvious plus for a mobile whip. And remember that the silver stays a good conductor even when it is oxidized.

The 5/8-wave length is excellent for two meters since it is long enough to provide a lower angle of radiation (more on the horizon) and thus an effective doubling of both transmitted and received power (+3dB) without being so long that it is a hazard or looks too much like a Charlie Brown whip.

Not wanting to make any holes in the Rover 2000TC, the Larsen NLA-150 antenna with NLA-TMB (trunk mount bracket) was used, plus a coax feedline and hardware mounting kit NLA-1K (installation kit). The price of the works came to $24.50 + 3.50 + 4.50 = $32.50. That's a pretty good deal for a complete trunk-mount antenna, with feedline and connector, all of commercial quality and built to last longer than the car.

For details on all of the Larsen antennas and various types of mounts you can get specifications from *Larsen Electronics, 11611 N.E. 50th Avenue, Vancouver WA 98665.* You might mention 73 when you write to them and address your letter to *Jim Larsen W7DZL.*

. . .Staff

Wm. Lowenberg, Jr. W200J
52 St. Clair Drive
Delmar NY 12054

HOW TO GET THE STUFF INTO THE HOUSE

Unless your QTH operates on the kind of budget that permits sable coat Christmas presents for the XYL, in-ground swimming pools for the kids, your own ski chalet at Aspen and casual weekend jetting to Acapulco or Majorca, chances are you are up against a problem that has faced nearly every ham since Marconi: *How do you get the stuff into the house unseen . . . or, alternatively, how do you avoid telling her how much it cost?*

Over a period of some years of supporting several hobbies and during which acquisitions of new and used cameras, lenses, fly rods, table saws, shotguns, sports cars, etc., to say nothing of radio gear, had to be explained, rationalized, lobbied or even concealed, this practitioner has assembled a variety of ploys, some from personal experience and others from fellow-hobbyists, whose contributions I acknowledge with thanks and whose identities I had best keep to myself.

In the hope that some fellow-sufferer may find herein the solution to his particular problem, I have decided to compile and publish the best of these stratagems in what might be called, *"Hamsmanship, or How to Build Your Amateur Radio Station Without Actually Shedding Blood."*

Old masters at the game – AM types and single-letter prefix gaffers – may find some of these tactics old hat. But they will realize that a whole new generation of amateurs has come along and, further, the problem of getting the stuff into the house without touching off domestic warfare has escalated astronomically in these days of nearly 100% store-bought stations. Even the newest Novice, judging from the magazine photos, starts his career with an array of commercial gear that looks like the control panel of an Apollo moonship.

These new hams need our help. Let us share with them our secrets and our methods. The future – possibly even the survival – of amateur radio may well be involved.

One word of caution before we begin the lesson: Do not, repeat, *do not* leave this copy of 73 lying about the house for *her* to read. Commit these pages to memory and then rip them out and either burn them or put them in an envelope and mail to Box 88, Moscow. That way they'll never be heard from again.

Now, then:

1. This one calls for the breezy, off-hand treatment. You bring in the new scope, linear, keyer or whatever it is and before she can start with, "How much did *that* cost?", you cry happily, "Boy, you couldn't beat this for $15" (or whatever figure the traffic will bear). Remember, you didn't *say* you paid only $15 for it – just that you couldn't beat it for $15 – and that's the gospel truth.

2. The David Harum or old-mule-trader ploy. You come gaily into the house with your latest treasure, a smug grin on your face, and emit something like, "Wow! Look what I traded old Haywire Magee out of for my old rotator." Never mind mentioning that you also forked over $250 in addition to that old rotator to make the "trade."

3. A variation of No. 2: Your line is, 'Can you imagine the dope letting this go for only $35?" You sure can't, OM. His rock-bottom price was $150 and that's what you coughed up. But you didn't *say* you paid $35.

4. Another variation: You take the old rig to your friendly local ham dealer who sells used gear on consignment for a commission. A few weeks later you report happily, "Some guy bought my old rig and I got enough for it to get this new one." Yeah, enough maybe for the down payment – but who needs to know you still owe the friendly local etc. $398.80?

5. Become a home-brewer. Spend long hours in the basement workshop. Cut lots of scrap metal loudly. Drill lots of holes ditto. Bang chassis around. Let the smell of soldering and scorched insulation permeate the house. Study schematics at the dinner table. On the air, talk loudly about the linear you're building. After two or three weeks of this, come proudly upstairs with the new rig, or whatever. Stripped of nameplate, of course, or even without front panel. Some time later you can "acquire" a cabinet or front panel for it and,."Look, Honey, this old Collins (or Heath or Swan or . . .) panel I picked up just fits the rig. Looks real commercial, doesn't it?"

6. You need a garage or workshop where you can cache the parts of a beam for this one. Then you make a big show of going into the shop with an armload of old aluminum tubing, busted TV antennas, etc. Emerge some days later, after the usual drilling and sawing noises, with the elements of your new tri-band beauty and, "See what I lashed up. Amazing that you can do with a bunch of old aluminum." It sure is.

7. Your XYL has been bugging you about getting a new color TV. So you agree to buy one if you can have the old one for parts. Show her those great articles about how you can build a five-band KW transceiver with the parts scrounged from old TV's. You'll be surprised, and you hope she will be, too, at the nifty new rig (frequency counter, oscilloscope or whatever it is you dream of) you were able to build with those old TV parts (plus a few odds and ends from Heathkit, maybe.)

Many other suggestions for inclusion in this article were considered and discarded for such reasons as requiring outright lying, being too impractical or far-fetched, or too susceptible of detection. Others simply were variations of one or more of the above, such as disassembling a Whizzbanger 2000 at a friend's shack and then bringing it home piece-by-piece in pocket-sized components; or installing a new KWM2 in your old Viking I cabinet.

None of those so far mentioned, however, can top the one reported by a ham who of necessity shall remain unidentified here. At the time the first color TV was acquired for the family, he convinced the XYL that only a 60-foot tower and super-duper king-size antenna would bring in the color picture in their location. To this day she thinks that three-element trapped Lightningbird tribander is what makes Doris Day look so pretty.

The best we save for last!

Write a piece for 73 Magazine, and with the fantastic price the editor pays you for it, you buy the KW.

. . .W2OOJ

Ed Webb W4FQM/1
Technical Editor

ANTI-CW AUTOSTART

An Anti-CW Autostart System for the Phase Locked Loop Terminal Circuit

A phase locked loop terminal unit has been in use in daily unattended operation on the 80 and 20 meter RTTY autostart nets for over six months with good success. The original development and operational features of the PLL TU were described in the January 1972 issue of *Ham Radio*. The detector card remains unchanged and its circuitry is shown only for the sake of continuity and clarity.

During the six months of testing it became apparent that the automatic signal acquisition and tracking (as well as automatic shift selection) capability of the PLL was not

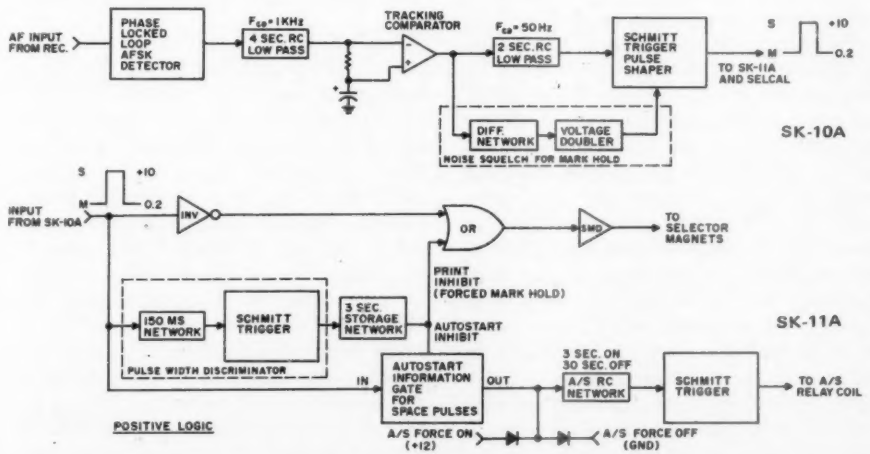
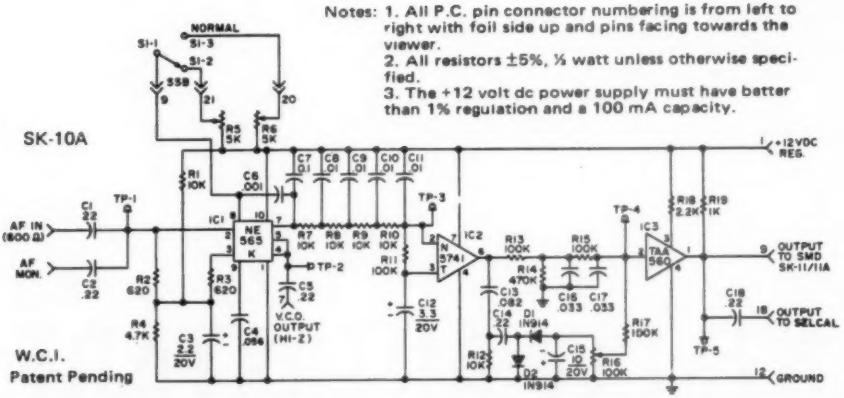


Fig. 1. Block diagram of TU.


Notes: 1. All P.C. pin connector numbering is from left to right with foil side up and pins facing towards the viewer.
2. All resistors ±5%, ½ watt unless otherwise specified.
3. The +12 volt dc power supply must have better than 1% regulation and a 100 mA capacity.
SK-10A
NORMAL
SSB
AF IN (600 Ω)
AF MON.
W.C.I.
Patent Pending
V.C.O. OUTPUT (HI-Z)
+12VDC REG.
OUTPUT TO SMD SK-11/11A
OUTPUT TO SELCAL
GROUND

(A) SSB mode input frequency range: 800–2200 Hz; VCO frequency set to 1500 Hz by R5.
(B) Normal mode input frequency range: 1800–3200 Hz; VCO frequency set to 2500 Hz by R6.
(C) Noise squelch adjustment R16 set for zero output at TP-5 with random noise input.

Fig. 2. Phase locked loop detector.

always an asset. In one case – that in which a CW signal came into the capture range of the loop – it proved to be a detriment. In this case the autostart would think that it was receiving valid RTTY information and cause the teleprinter motor to turn on, the result being a few feet of paper with nothing but garbage on it.

PLL AFSK Detector Characteristics

The PLL detector was designed to operate with low input tones from SSB transceivers or the normal range RTTY tone frequencies at the flip of a switch. The PLL detector would respond only to an AFSK signal that shifted higher in frequency during the space pulse. The PLL VCO normal resting frequency is set at the mid-range point of the lock frequency or capture range. If a CW signal appeared anywhere in the frequency range between the VCO resting frequency and the upper capture limit frequency the TU would lock on it as it thought it was a valid AFSK signal and it would activate the autostart. This condition will only occur when there is no valid RTTY signal present or if the CW signal is more than 8 dB stronger than the RTTY signal. The PLL has a capture effect much like that of an FM receiver.

Autostart and Selector Magnet Drive

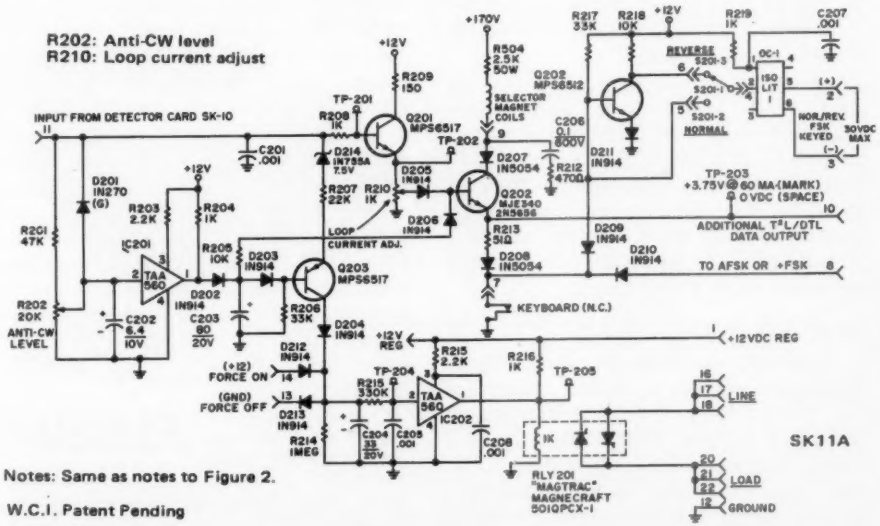
The original autostart was activated by space pulses charging an RC time constant to a predetermined trigger level. This trigger level caused a Schmitt Trigger to fire and activate the solid state motor control relay. The mark and space pulses drove an inverter that in turn drove a constant current type of selector magnet driver. The SMD (Selector Magnet Detector) gave extremely fast rise and fall tim.es. The selector magnet keying pulses had very flat tops and little overshoot.

Anti-CW Autostart

The RTTY character having the longest space condition is the "BLANK" key. This character has all of its 5 level 22 ms information bytes in the space condition. These, plus the start pulse, have a total space condition of 132 ms at 60 wpm (45 bauds). Therefore we can add a little safety margin and say that any AFSK signal that causes the PLL detector to go to the space condition for more than 150 ms is not RTTY. Most CW signals under 15 wpm have "Dahs" longer than 150 ms and thus would activate a pulse width discriminator. The pulse width discriminator would be set for 150 ms and be fed by space pulses. In this case the output from the PLL detector is 0 for mark and +10V dc for space. These space pulses

are fed to both the selector magnet driver inverter stage and to a voltage divider R201 and R202. The output arm of R202 is connected to C202 that is in parallel with the input to Schmitt Trigger IC201. R202 and C202 form a simple RC charging circuit that is charged by the positive 10V space pulses from the PLL detector. The time or pulse width that it takes a space pulse to charge C202 up to the Schmitt Trigger's input firing point of about +1.5V can be set by adjusting R202. The positive space pulse is also applied to D201 and reverse biases it. However when the input from the PLL detector goes to the mark condition of almost 0V dc, the positive charge on C202 is discharged through D201. This way each time a mark signal or no signal is received (there is no output from the PLL on noise because of the noise squelch), the RC timing circuit is reset to almost zero and ready to measure the next bit of space information. R202 is adjusted so that any space pulse greater than 150 ms will charge C202 to the Schmitt Trigger (IC 201) firing point. When the Schmitt Trigger fires, its positive output pulse is conducted through D202 to charge C203.

R204 allows C203 to charge through D202 in 8 ms. Even if a mark pulse is received now and the output from Schmitt Trigger went to the zero state, C203 would remain charged because D202 would be reverse biased. C203 functions as a mark-hold or non-print memory. The positive charge on C203 is conducted through R205 and D206. This forward biases the selector magnet driver (Q202) and causes current to continuously flow through the selector magnet coils. This prevents the teleprinter from printing. The same positive charge that forward biased the SMD (Q202) also reverse biases D205. This allows the mark-hold memory to override input information from the PLL detector to the SMD. Q203 is a series gate that is normally biased on. It allows the positive space pulses to flow through D214, R207, and D204 to the autostart time constant formed by C204 and R214. When enough positive space pulses charge C204 to the second Schmitt Trigger (IC22) firing point it fires and goes to the high state and turns on the solid state teleprinter motor control relay. But when C203 is charged and puts the teleprinter in the print hold condition, part of its (C203) positive charge also forward biases D203 and this reverse biases Q203. When Q203 (series gate) turns off no further positive space pulses are allowed to flow to the autostart



Notes: Same as notes to Figure 2.

W.C.I. Patent Pending

Fig. 3. Anti-CW autostart.

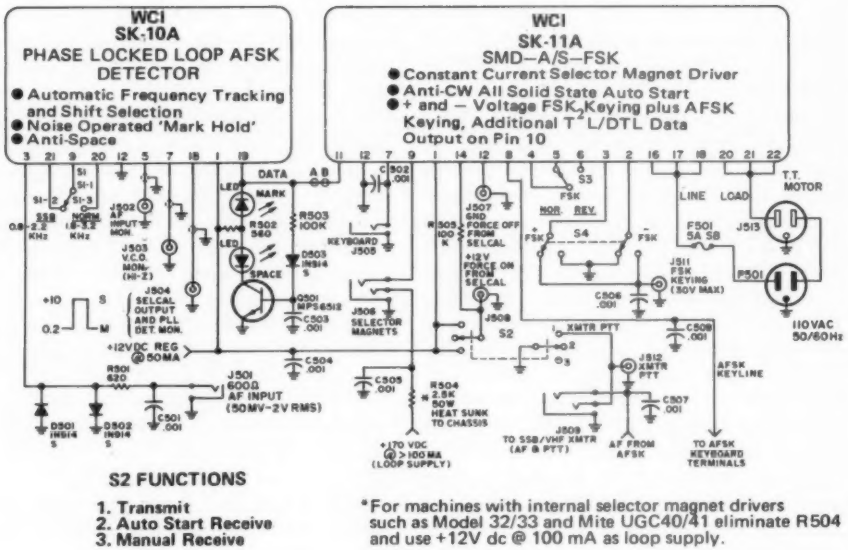

WCI
SK-10A
PHASE LOCKED LOOP AFSK DETECTOR
● Automatic Frequency Tracking and Shift Selection
● Noise Operated 'Mark Hold'
● Anti-Space
WCI
SK-11A
SMD–A/S–FSK
● Constant Current Selector Magnet Driver
● Anti-CW All Solid State Auto Start
● + and – Voltage FSK Keying plus AFSK Keying, Additional TTL/DTL Data Output on Pin 10
S2 FUNCTIONS
1. Transmit
2. Auto Start Receive
3. Manual Receive
*For machines with internal selector magnet drivers such as Model 32/33 and Mite UGC40/41 eliminate R504 and use +12V dc @ 100 mA as loop supply.

Fig. 4. Interconnect wiring.

RC circuit. Thus if the teleprinter motor is off it will stay off. If it is on, the lack of autostart positive space pulses will cause the printer motor to turn off in 30 seconds. Once the CW ceases, the TU will allow the teleprinter to go back to the print condition in 3 seconds after the last space pulse of more than 150 ms. At the same time the autostart gate is reopened.

A RTTY AFSK signal will turn the teleprinter on in 3 seconds. The teleprinter solid state motor control relay has a delayed dropout of 30 seconds. Even during this 30 second dropout time if a CW signal should appear in the upper capture range of the PLL detector the anti-CW circuit will function and place the teleprinter in a non-print condition.

AFSK–FSK Keying.

Keyboard outputs are provided to key an AFSK oscillator and an inverter option that keys an opto-electronic isolator that is used to key a negative FSK voltage. Such a voltage is found on the Signal One CX-7A. But provision is also made for keying a positive voltage FSK at the flip of a switch. The maximum voltage across the output of the opto-electronic isolator is 30V dc. An FSK reversing switch is also provided on the main frame wiring schematic.

Adjustments for the Anti-CW and SMD Card

There are only two adjustments so that a VOM and screwdriver will be all that is required. With the teleprinter connected, monitor TP-203 with the VOM and adjust R210 for a reading of 3.75V. This indicates a loop current of 60 mA. Then while receiving a 60 wpm RTTY signal, adjust R202 to the point where the machine occasionally goes into the mark-hold (non-print) mode and then back the pot off just a little. That's it; nice and simple. Now when you come back to read the copy on the teleprinter there will be no more "junque" caused by CW.

. . .W4FQM/1

NOTE 1. IC202 and 202 are by AMPEREX ELECTRONICS CORP.

NOTE 2. P.C. boards and built P.C. boards are available from WCI, P.O. Box 17, Schaumburg IL 60172.

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EXTRA CLASS LICENSE STUDY GUIDE

Questions & Answers Part II

21. How does the beat frequency oscillator affect the tuning of a single sideband signal?

A. Extremely. The bfo signal takes the place of the original (and suppressed) carrier, and must be properly positioned. Thus the bfo tuning and the main tuning interact. With unselective receivers, the bfo pitch adjustment may be used for fine tuning. With narrowband receivers, the bfo should be set to place its signal at the proper point on the filter's passband, and the main tuning alone used to tune in the signal.

22. Can a lossy transmission line be used to transmit signals? Explain.

A. Yes. No matter how great the loss in the transmission line, at least a small part of the original energy will appear at the load end of the line. If losses are high, however, only a very small part of the input energy will appear at the output, and line efficiency will be low. If losses are sufficiently high and the line is sufficiently long, the energy appearing at the output will be insignificant. Thus at VHF, several hundred feet of lossy coaxial cable may be used as a highly efficient dummy antenna.

23. How can you distinguish between a product and an envelope detector?

A. The presence or absence of a bfo is a sure indication, in that every product detector requires a bfo. Thus if no bfo is present, the detector must be an envelope detector. However the converse is not true; many envelope detectors have bfo's associated with them to inject a local signal into the envelope prior to detection. In general, both detectors operate in the same way: each is a non-linear mixer circuit, which demodulates the incoming signal by mixing the sidebands with the carrier. Thus when the bfo is off, a diode detector acts as an envelope detector, while with the bfo turned on, the same detector is a product detector.

24. How can a receiver be adjusted for SSB reception when the receiver does not have a product detector?

A. See question 23. Strictly speaking, if the receiver is incapable of product detection it is incapable of receiving SSB signals as such. The SSB signal can be converted into one containing a carrier by external carrier injection, using the transmitter vfo or a separate signal-frequency oscillator.

In general, however, the term "product detector" is used for a special kind of product detection circuit tailored to best reception of SSB signals; many receivers which are capable of product detection do not have "product detectors" in this sense. With such a receiver, audio gain should be turned all the way up and output adjusted by means of the rf gain control (to assure that the SSB signal is weak, at the detector, in comparison to the bfo signal). The bfo should be turned on, and the signal carefully tuned using both main tuning and bfo pitch controls until the speech becomes recognizable.

25. How do mica and paper dielectric bypass capacitors compare at different frequencies?

A. Mica capacitors have much lower internal inductance than do paper capacitors, due to differences in their construction. The difference is negligible at frequencies below the broadcast band, and may be tolerated at frequencies up to 4 or 5 MHz, but as frequency increases, the paper capacitor behaves more as a coil than a capacitor and mica or ceramic units must be used. Mica can be used into the VHF range; ceramics can be used through UHF, with care.

26. Discuss the advantages and disadvantages of electrolytic versus paper filter capacitors.

A. For the same capacitance value and voltage rating, paper and electrolytic filter capacitors compare as follows: paper is bulkier and more expensive than electrolytic, but has higher leakage resistance and much better resistance to aging. The electrolytic capacitor has many disadvantages, including low precision of capacitance value, variation of value with age and applied voltage, sensitivity to polarity of applied voltage, and a tendency to dry out. These are all, however, of little importance in power-supply filter applications. Paper capacitors may have much greater inductance than electrolytics (which may be constructed in a non-inductive manner).

27. Where in a receiver circuit should a limiter/blanker stage be placed to provide maximum utility?

A. Since the limiter/blanker circuit's purpose is to remove sharp impulse noise spikes from received signals, and such spikes cause highly selective circuits to "ring," the circuit should be placed ahead of all highly selective circuits for best results. Such a circuit usually is placed between the first mixer and first i-f strip, as a compromise between circuit ringing and achieving enough amplification to operate the blanker.

28. What frequency should a crystal oscillator circuit be tuned to for maximum stability?

A. That frequency which provides the minimum amount of feedback voltage across the crystal, while maintaining oscillation and good "starting" qualities. Usually this will be a frequency somewhat higher than the crystal's operating frequency.

29. What are microwave frequencies? What type of oscillator is commonly used to generate microwaves?

A. The term "microwave" is a loosely defined concept referring to frequencies higher than the UHF region yet lower than visible light. In general, any frequencies above 1 GHz (1000 MHz) may be considered "microwave." Another term often used now for similar frequencies is "millimeter waves," which refers to frequencies with wavelengths measured in millimeters rather than meters.

Three types of oscillators are commonly used to generate microwaves. They are the magnetron, the klystron, and the traveling-wave tube (TWT). All operate on velocity principles, rather than the intensity principles used at more familiar frequencies.

30. What are some of the factors that affect the field strength of a signal from a radiated antenna?

Field strength is influenced by many factors. A primary factor is the amount of power applied to the antenna for radiation. Another is the distance between antenna and measuring point, since field strength falls off as the square of the distance. Still another is the directional pattern of the antenna, which determines what proportion of the applied power is radiated in any specific direction. Reflections and multiple transmission paths can cause variation of field strength with small changes of measurement position, and both atmospheric and ionospheric conditions can cause field strength to vary from day to day. Signal frequency plays a large part in determining how the other factors affect field strength. For this reason, field strength is almost impossible to predict, and must be measured for an accurate determination in any specific case.

31. What factors determine the frequency at which a quartz crystal will oscillate? List some of the advantages of using crystals in amateur equipment.

A. A quartz crystal's oscillating frequency is determined primarily by physical

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CORE SIZE	.41 Mix Green 'HR' 20 kc - 100 kc μ=75	.3 Mix Gray 'HP' 50 kc – 1 mc μ=30	.2 Mix Red 'E' 500 kc – 30 mc μ=10	.6 Mix Yellow 'SF' 10 mc – 90 mc μ=8	.10 Mix Black 'W' 30 mc -150 mc μ=7	.12 Mix Grn-Wh 'IRN-8' 60 mc – 200 mc μ=5	Outer Diameter (inches)	Inner Diameter (inches)	Height (inches)
T-200	$2.50	$2.75	$3.00	$3.50			2.000	1.250	.550
T-130	1.50	1.75	2.00	2.50			1.300	.780	.437
T-106	.95	1.00	1.00	1.50			1.060	.560	.437
T- 94	.70	.75	.75	.95			.942	.560	.312
T- 80	.55	.60	.60	.80	.90		.795	.495	.250
T- 68	.45	.50	.50	.65	.75		.690	.370	.190
T- 50	.40	.45	.45	.50	.60	.65	.500	.303	.190
T- 37	.30	.40	.40	.45	.45	.55	.370	.205	.128
T- 25	.25	.30	.30	.35	.40	.45	.255	.120	.096
T- 12	.25	.25	.25	.25	.25	.35	.125	.062	.050

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dimensions of the crystal and by the "mode" of mechanical flexure within the crystal itself, and also may be modified by temperature and by the external circuit to some degree.

The major advantage of using crystals in amateur equipment is that it provides the most stable resonator yet known, so that oscillation remains on the same frequency for the same crystal within very narrow limits. Other advantages include ease of frequency determination and the ability to switch from one operating frequency to another and return without tedious adjustment, by replacing one crystal with another.

32. Explain the properties of a quarter-wave section of rf transmission line. How would these properties change if the output ends of the section were short-circuited?

A. An open-circuited quarter-wave section of rf line has the properties of a series-resonant LC tuned circuit. That is, its impedance between terminals is very low (nearly a short circuit). Apparent Q of such a resonator is very high, and tuned lines are used in VHF transmitters as tank circuits.

A shorted quarter-wave section reverses its characteristics to those of a parallel-resonant LC tuned circuit, and offers high impedance (nearly open circuit conditions) at its input terminals. Such a line may be used as an insulator.

A quarter-wave line connected between two different impedances acts as an impedance transformer; the output impedance for matching conditions is equal to the line's impedance, squared, divided by the input impedance value. Conversely, line impedance in order to match must be equal to the square root of the product of input and output impedance values.

33. How should a wave trap be connected to a receiving antenna circuit to attenuate an interfering signal?

A. A parallel-tuned wavetrap should be connected in series with the antenna and receiver so that all incoming signals must pass through the parallel-tuned circuit before reaching the receiver. A series-resonant wavetrap should be connected across the

receiver's input terminals in parallel with the antenna, so that it shorts out the undesired signal. Both types of wavetraps may be used at the same time if desired. At VHF and above, quarter-wave line sections may be used as wavetraps (refer to question 32 for parallel between line sections and tuned circuits).

34. Why are synchronizing pulses transmitted with television signals?

A. To assure that the horizontal and vertical sweep rates at the receiver are the same as those at the transmitter, thus making certain that the electron beam is at the same spot on the picture tube face as compared to the camera's scanning beam at each instant during the transmission.

35. How may an amateur check his transmitter for spurious sidebands?

A. By use of a selective receiver. The transmitter should be operated at minimum power into a dummy load to avoid overloading the receiver's input circuits, and the receiver then tuned over a wide range (several kHz) either side of the transmitter's signal while normal modulation is applied. Spurious sidebands will appear as "splatter" or "buckshot," coinciding with voice peaks usually but not necessarily.

36. How can the safe power input to a crystal oscillator circuit be determined?

A. The "safe" power input, not to be confused with the "proper" power input, may be determined by operating the oscillator at various power levels, increasing power each time, and observing the output signal for 30 seconds or more at each level. When power input approaches the "unsafe" region, the heat generated in the crystal will cause its dimensions to change, thus making its output frequency drift. The more unsafe the condition, the more rapid the drift of frequency. "Proper" power input is well below the unsafe level; it is the minimum which will produce reliable oscillation.

37. Define the term decibel. How is the decibel used for voltage and power calculation?

A. The decibel is one-tenth of a "bel." The "bel," in turn, is a measure of the ratio between two power levels, and is the logarithm (to base 10) of that ratio. The mathematical formula defining the decibel (abbreviated dB) is:

$$dB = 10 \log_{10} \frac{P_2}{P_1}$$

DB are used to compare voltages, but the comparison is meaningful only when the voltage is converted to a power level unless both voltages appear across the same impedance. If both voltages appear across the same impedance, dB can be used with voltage ratios. Since power varies as the square of the voltage, the square of the voltage ratio must be used. This is accounted for in the formula by multiplying the log by 2, to produce the familiar 20-time factor.

A dB value of "0 dB" indicates that both powers are the same, or both voltages. a 3 dB ratio indicates that one power is twice the other, or one voltage is 1.414 times the other. A 6 dB ratio indicates 4 times the power or twice the voltage. A 10 dB ratio indicates a 10-to-1 power ratio or 3.16228-to-1 voltage ratio. A 20 dB value indicates a 100-to-1 power ratio or 10-to-1 voltage ratio.

The usefulness of the dB system of measurement lies in the fact that it measures a ratio rather than absolute values, and almost all measurements and calculations to which it is applied are affected much more by ratio than by absolutes.

38. How are the emitter, base, and collector of a transistor biased for amplifier operation? How are they biased for cutoff (open circuit) and saturation (short circuit)?

A. For amplifier operation, the base-emitter junction of the transistor must be forward biased (conducting) while the collector-base junction is reverse biased (non-conducting). Bias values and the amount of current injected into the base-emitter junction are chosen so that conduction occurs between collector and emitter, and the amount of conduction which occurs is determined by the value of base current.

In switching operation, to achieve cutoff the base-emitter junction is reverse biased (non-conducting) which blocks vir-

tually all conduction in the collector-emitter circuit. Saturation is obtained by forward bias of the base-emitter junction, with injection of maximum current. In both cases, the collector-base junction is reverse biased.

Note that the only difference between amplifier operation and the saturation condition is the amount of current injected into the base-emitter junction. With some types of transistors, no reverse bias is necessary to achieve cutoff; merely reducing the injection current to zero does the job.

Transistors designed for amplifier use are built to operate best in the transition region between cutoff and saturation; those designed as switches are built for minimum resistance in saturation with maximum resistance at cutoff, and properties in the transition region may be neglected. However many devices designed for one purpose work well for the other, and vice versa.

39. How do NPN type transistors differ from the PNP type? How does their bias differ?

A. Transistors always consist of two types of semiconductor material in three regions, forming the emitter, base, and collector. The types of material are "N" type, which has an excess of electrons, and "P" type, which has a shortage.

An NPN transistor uses N-type material for emitter and collector, with P-type for the base. A PNP, on the other hand, uses P-type for emitter and collector, and N-type for the base.

Polarity of all bias connections is reversed from one type to the other. For instance, an amplifier circuit in the conventional common-emitter configuration may have the emitter grounded, with negative bias going to both collector and base through appropriate resistors, to establish the required bias conditions for a PNP transistor. If an NPN is used in the same circuit, the bias polarity must change from negative to positive.

40. How can the output circuit of a transmitter be adjusted to increase or decrease its coupling to the antenna system?

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of man-made signals such as "ignition noise" or the "static" caused by sparking at the contacts in electric motors. Electrically, however, these are signals; "noise limiters" deal with these unwanted signals, which are most usually generated by the sudden interruption of current flow which may or may not be accompanied by a visible spark.

Natural "noise" is a random change of energy level, which is more or less evenly distributed across the electromagnetic spectrum, and is not "coherent" (that is, it has no specific frequency as such). In the audio range, it manifests itself as a hiss or frying sound.

Such noise is basically due to the statistical unpredictability of energy-level changes within the individual atoms which go to make up the universe, and because of this is always present. In amateur practice, it is generally characterized by its apparent origin. Thus we have, for example, "antenna noise" which is present with the signal when it arrives from the antenna. This is, in turn, composed of "galactic noise" which arrives from outer space, "atmospheric noise" which originates within our own atmosphere and ionosphere, and "thermal noise" which originates within the conductors of the antenna and feedline (as well as within the components of the amplifier's first rf amplifier stage). Noise of this sort is always proportional to temperature; the higher the temperature, the greater the noise voltage. In fact, in radio astronomy noise levels are measured in "degrees Kelvin" which are a measure of the temperature of the apparent noise source.

Besides antenna noise, we have "receiver noise," which includes thermal noise in the components ahead of the first rf stage, "shot noise" in the tube or transistor of the first stage, "partition noise" from multi-grid tubes in the rf amplifier chain, and "mixer noise" contributed by the mixer stage(s).

All these noise voltages, except for man-made "noise" signals, are very low, but with the high amplification available in most receivers, provide a lower limit to the receiver's sensitivity.

A. The output coupling adjustment depends upon the type of output circuit used. A pi-network output circuit's coupling is determined by the output capacitor; the more capacitance, the less the coupling. A link-coupled circuit is determined by physical coupling of the link to the final tank; the closer, the greater the coupling.

41. How do filters attenuate harmonics emissions?

A. We assume that the question refers to low-pass filters, since high-pass filters would not attenuate harmonics, and a bandpass filter would reduce harmonics in the same way as does a low-pass unit.

The filter consists, then, of one or more sections which contain series inductance and shunt capacitance. Reactance of the inductance rises with frequency while that of the capacitance falls. The harmonics being at a higher frequency than the desired signal, their energy is opposed by the increasing reactance of the inductance, and finds a ready path to ground through the reduced reactance of the capacitance.

In some cases, resonant circuits are employed to trap out specific harmonic frequencies. Refer to questions 32 and 33 for discussion of wavetraps.

42. List several advantages and disadvantages each for Class A, Class B, and Class C amplifier operation.

A. Class A offers greatest linearity (least distortion) and simplest adjustment during operation, but is least efficient in use of input dc power and is limited in power-handling capability.

Class B offers improved efficiency and power output capacity, but at the cost of increased distortion and critical adjustment.

Class C has highest efficiency and relatively uncritical adjustments, but inherently distorts the signal and so cannot be used when the signal envelope must be preserved. It also produces much greater harmonic output.

43. What are some different types of noise voltages encountered in amateur receivers? How is each type generated?

A. The word "noise" may be misleading, because much "noise" actually consists

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44. What are current and voltage characteristics along a transmission line when it is matched and mismatched?

A. Assuming that the line has losses so low that they may safely be neglected, in a matched line the current will be the same at any point, and so will the voltage.

When a mismatch exists, the current and voltage values will vary cyclically along the line, repeating every half-wave along the length of the line, and current and voltage will not necessarily be in phase with each other. The ratio between minimum and maximum is expressed as "standing wave ratio," and is proportional to the ratio of mismatch. That is, a 50Ω line terminated in 100Ω will display a 2-to-1 ratio between maximum and minimum voltage, and has a VSWR of 2.0.

45. How do receivers for remote control of objects and regular type communications receivers differ in basic operation?

A. Normal communications receivers are intended to provide information to human beings, and normally do so in the form of audio signals through headphones or loudspeakers (although an RTTY station does so via printed words on paper). Remote-control receivers, on the other hand are intended to provide information to machines to control their actions, and normally do so without output transducers such as phones, speakers, or printers, by means of electrical signals which directly actuate the controls.

In addition, communications receivers usually offer continuous tuning over several frequency bands, if not the entire spectrum, while remote-control receivers are usually fixed-tuned on a limited number of channels. However, some commercial communications receivers (such as those used in aircraft communication) are fixed-tuned, while nothing prevents incorporation of continuous tuning in a remote-control receiver. The output-signal distinction is the defining difference in characteristics.

This marks the half-way point in the FCC study list. Questions 46 through 90 will be continued in June *73*.

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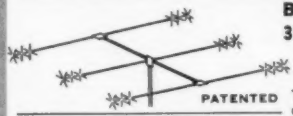

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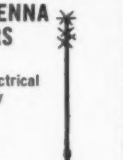

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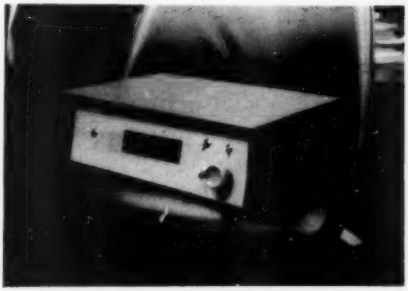

Part 1 of 3 parts

Frequency counters have been finding their way into more and more ham shacks since two-meter FM activity made accurate frequency measurement a must. Even some sideband equipment now comes with digital frequency readout.

Although a number of frequency counter designs have appeared in *73* and elsewhere, we decided it was time to come up with a new design. We have gone out of our way to make the building of this counter as easy as possible, and yet to produce a counter of really top-notch performance. The complete information you need to build your own counter will be presented in three parts. This month we will give a complete description of what the counter is and what it can be used for, as well as the complete parts list so you can start collecting parts if you decide to go ahead. Next month we will give the complete logic diagrams and theory of operation. The month after that we will have the printed circuit board layout, parts layout drawings, and construction and operating information.

And now a little information about the counter:

1. The basic counter measures up to 20 MHz, although many IC's go past that. One of our prototypes goes up to 35 MHz, and the other goes to about 40 MHz. But that's only the basic counter – an optional VHF pre-scaler mounts on the same board and extends coverage to above 200 MHz. Depending on the IC's, you may get operation higher than that. We've had our prototype counting at the upper limit of our signal generator, which is 250 MHz. With a simple modification, the scaler range can be increased to typically 320 MHz though at reduced sensitivity.

2. It is easy to build. Except for the power supply, all other small parts fit onto one 7 x 10 in. printed circuit board. This means there's a minimum of external wiring and less chance for error. The p.c. board layout, etched boards, and complete parts kits are available to make the job even easier.

3. The resolution is within 1 Hz with the basic counter up past 20 MHz, and within 10 Hz with the VHF scaler. The accuracy depends on the quality and type of reference crystal used; the circuit allows you to zero-beat the crystal against WWV. With the AT-cut series-resonant crystal suggested the specs say that the drift should be less than 0.5 parts per million (ppm) per month (equivalent to about 75 Hz at 2 meters) and

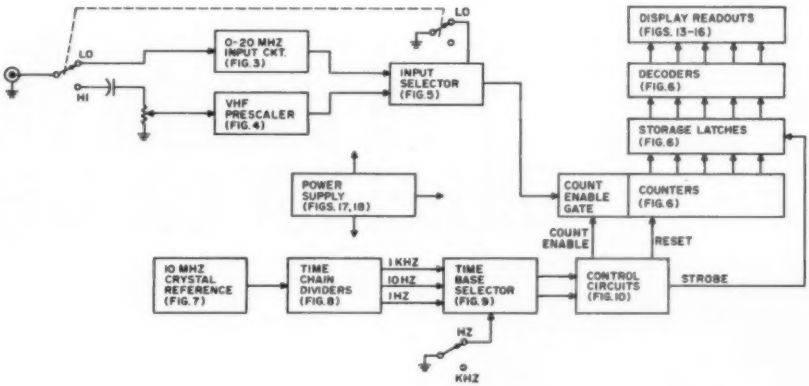

Fig. 1. Counter block diagram.

the temperature coefficient should be about 0.077 ppm per degree Centigrade (about 12 Hz at 2 meters). In our counter the crystal is mounted close to the edge of the p.c. board with the idea that someday we will place it in a crystal oven. Let's face it – the measurement accuracy is only as good as the reference crystal accuracy, and all the really expensive commercial counters have crystal ovens. (The Heathkit doesn't and it drifts with temperature.) Although we will not describe an oven in this article, we suggest you keep it in mind for that certain "someday."

4. The design is really up to date. It uses the latest TTL and ECL integrated circuits. To simplify construction, complex MSI (Medium Scale Integration) IC's are used to reduce the number of interconnections. Although the board is laid out for Numitron readout tubes, light-emitting-diode (LED) readouts can be used to provide state-of-the-art reliability as well as really snazzy looks.

5. The price is really reasonable. Complete with all parts, including cabinet line cord and all the other necessary things so often forgotten in parts estimates, the entire counter *with* VHF prescaler will cost you about half of what you'd pay for the cheapest commercial units, including kits. Here's how the price breaks down into the various portions of the counter.

a. Basic counter circuitry including all IC's and small parts, but not including VHF prescaler, readout indicators, and power supply – about $65.

b. Power supply – about $15.

c. VHF prescaler, optional – about $25.

d. Readout indicators and associated circuitry.

The price depends on which indicator type you choose. Numitron readouts will add about $25, miniature incandescent readouts (sometimes called Minitrons) will cost about $20, and LEDs will cost about $35 (prices from one source dropped to $6 per LED at the time of writing, and we expect other dealers to follow suit.) Though the Minitrons are the cheapest, we don't really recommend them since the $5 saving over Numitrons doesn't justify the added work. Numitrons are viewed from the side, and plug right into the p.c. board. In this way you can read the digits from the front of the board. The Minitrons, on the other hand, are viewed from the top. This means you need a separate p.c. board, mounted at right angles to the main board and in front of it, to provide a convenient readout. Those two boards will connect to each other with 38 wires! Incidentally, the LEDs mount the same way, but that's the price of progress.

e. Cabinet, input connectors, test leads, assorted hardware etc. – about $15.

These prices assume you have to go out

and buy all new parts, though not necessarily from a dealer who charges list price. Quite a few of the IC's are available at below-cost prices from a number of mail order outlets around the country, and we used these prices in calculating the total price.

If you have a modest sized junk-box, you may be able to shave these prices a bit, but don't expect miracles. Unless your junk-box is very modern, it probably won't contain too many useful parts aside from things like switches, connectors, fuse and line cord, and the like. Still, it seems quite reasonable that with a little effort you could build the complete counter with Numitron readout but less VHF scaler for less than $100, and for about $125 with it. This is roughly half or less of the price of the Heathkit counter or counter/scaler combination. And it isn't much more than some commercial VHF scalers alone.

Interested? Then let's get on with the description. Figure 1 shows a fairly complete block diagram of the entire counter. The individual diagrams for each block will be shown next month, and the block diagram gives the figure number for the detailed diagram.

The input signal is fed by the HI-LO switch to either the 0–20 MHz input circuit, or to the VHF prescaler. The low frequency input circuit just converts the input signals into digital pulses, while the VHF prescaler divides the input frequency by 10 to bring it into range of the rest of the counter circuitry. The outputs of these two circuits are sent to the input selector, which selects one input and sends it on to the count enable gate, which is part of the counters. The count enable gate is opened by the control circuits for a specified length of time, and the number of cycles during that time is counted by the counters. The count is then transferred into the storage latches, which hold the count while the counters take the next count, to produce a non-flickering display. The output from the storage latches goes to the decoders, which then feed the display readouts. The display shows a five-digit number and has an over-range light if the count exceeds five digits.

The time reference for the count enable gate comes from a 10 MHz crystal oscillator,

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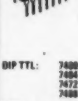

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whose output is divided by seven decade counters in the time chain divider circuit, to produce 1 kHz, 10 Hz, and 1 Hz pulses which go to the time base selector. The selector chooses the correct frequency pulse train, and sends it to the control circuits.

The control circuits govern the basic timing of all functions of the counter, and generate the count enable, strobe, and reset signals, in that order, over and over. Thus the counters are allowed to count for a certain amount of time, then the count is transferred (strobed) into the storage latches, the counters are reset back to zero, and then the count enable comes again for the next count.

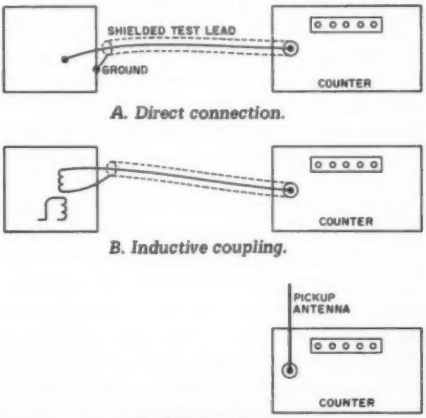
One of two measurement periods is selected by the Hz-kHz switch. Assuming that you are not using the VHF scaler, the Hz position of the switch results in a count enable signal lasting exactly one second. Thus the counters count the input frequency for exactly one second, and the five-digit display then shows the right-most five digits of the total count, up to a maximum of 99999. If the actual input frequency is higher, the readouts still show the right-most five digits, but an over-range light indicates that there are more digits to the left. For example, suppose the input frequency is 1,234,567 Hz. Then the readout shows the digits 34567 and the over-range light is on.

If we want to see the digits to the left, we just move the switch to the kHz position, which selects a count enable period of 1/1000 second (1 millisecond). If the input frequency is 1,234,567 Hz, then there will be 1,234 cycles in that millisecond, and the readout will show the digits 01234. Put the two readings together, and you have a readout down to the last cycle.

Top view of counter.

Using the VHF scaler, all input frequencies are divided by 10. For example, if we want to measure a 146.940123 MHz signal, the scaler converts the frequency to 14.694012 MHz. In the kHz position of the Hz-kHz switch we will have a readout of 14694, while in the Hz position we will get 94012 with the over-range lamp lit. Thus we have resolution down to 10 Hz.

While it may seem a bit inconvenient to have to use two readings to get an accurate frequency indication, there are two good reasons for doing it this way. First, to get the frequency in just one reading, we would need an 8-digit readout instead of five. That means three more counters, three latches, three decoders, and three indicators. That's an increase of 60% in price in that part of the counter. If price is no object, it's easy to add the extra parts yourself.



A. Direct connection.

B. Inductive coupling.

C. Pickup antenna.

Fig. 2. Coupling the counter to external equipment.

The second reason is that to get an accurate readout down to the last cycle (or last ten cycles with the VHF scaler) takes a whole second of counting. If you don't need that accuracy, that's a relatively long time. In the kHz position we get a new reading every 1/10 second, which really speeds up the process, especially if the frequency is changing and you want to follow the change.

Before we get on to the parts list, it might be a good idea to look at some applications of the counter. Figure 2 shows some typical

ways to connect the counter to a circuit to measure the frequency of a signal. Just because measuring the frequency of a 2-meter FM rig is the most obvious, we'll leave that for last.

Figure 1A shows the easiest way – connecting directly into a circuit. The low-frequency input circuit on the counter has an input impedance of about 1 MΩ, shunted by less than 20 pF, approximately. The VHF scaler has an input impedance of 50Ω. But avoid overdriving the inputs to avoid damage. The low-frequency input can stand voltages up to about 100V peak, though it may not count well at inputs over 20V. The VHF input uses a 50Ω attenuator, and you should make sure not to overdrive the input stage, since this may damage the input circuit or slow it down (for highest speed it's necessary to keep the input transistors from saturating, which means keeping the level just above the point where the counter just starts counting). The best habit here is to start with the attenuator at minimum and turn up just enough to get a good reading.

It's hard to give a sensitivity figure for both inputs since we don't have voltmeters capable of measuring at rf frequencies. But it appears that the low-frequency input needs about 200 mV rms, and the VHF input needs about 400 mV. Incidentally, both inputs have input isolation capacitors, so the counter can be connected to a point where a small dc voltage is present. But watch out, and don't exceed the breakdown voltage of the capacitor you use. This limits the low-frequency input to frequencies above about 20 Hz; if you want to go below that you will just have to increase the value of the isolation capacitor, or remove it altogether.

Using the direct connection, we've been able to measure the frequencies in tube-type equipment as well as low-level transistor circuits. But don't try to connect the counter to your power amplifier! A very useful way of putting 2-meter gear on frequency has been to connect the counter to the output of the oscillator, and measure the frequency right there.

When you have a high-power stage, or a stage where you don't want to make a direct connection, the best way is with an inductive loop as shown in Fig. 1B, much like a

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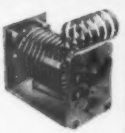

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wavemeter would be used. If you are working with a high-power stage, start with the counter loop far away, and only gradually bring it closer until you just get a reading. A very useful coil to use as the pickup loop is a coil from a grid-dipper (GDO).

Incidentally, we have found that the counter makes the GDO into an extremely useful device. The problem with most GDOs (and signal generators as well) is that their frequency calibration is terrible. But the counter solves all that – just take the next higher frequency GDO coil, connect to the counter, and use as the pickup loop, an inch or so from the GDO coil. By measuring the actual frequency your GDO is putting out, you can align a tuned circuit right on. To find out the frequency of an unknown received signal, just beat the GDO against it and read the frequency. If the GDO doesn't go that high, use a harmonic. For example, we wanted to find out the frequency of a signal in the 160 MHz public service band. We tuned in the signal on a cheap VHF monitor radio, beat the tenth harmonic of a 16 MHz signal from the GDO against the unknown, and read the 16 MHz frequency on the counter. Multiply by ten, and you have the right value, and you don't even need the VHF scaler.

Another application along the same line comes when you have a real low-level stage, where there just isn't enough signal to count the frequency directly with the counter, or where there are several frequencies at the same time, as in a reflex amplifier. We solved that by plugging an earphone into the GDO, zero-beating it against the unknown, and reading the GDO frequency with the counter.

Finally, Fig. 1C shows how to measure the frequency of a transmitter – just connect the counter to another antenna near the transmitting antenna. We've used this approach at 2 meters, with a 19-inch piece of wire connected to the counter. We've been able to measure the frequency of a 1W handie-talkie about five feet away, which shows that the sensitivity is quite good.

To end the overall description of the counter, the parts list provides a complete list of everything you need to build the counter. The parts list is divided into 5 parts.

LED readouts.

Part A has all the basic counter parts except for the readouts, the VHF scaler and the power supply. All of these parts fit on the main 7 x 10 in. printed circuit board, except for the Hz-kHz switch which mounts on the front panel.

Part B describes the power supply, which provides a regulated +5V ±5% at about 1.5 amperes and +25V unregulated at about 10 mA. There's quite a bit of room for experimentation here, but make sure that the +5V supply voltage is well regulated. The diodes and filter capacitor for the +25V supply mount on the main p.c. board, but the +5V supply mounts separately. We did not design our own p.c. board for the +5V supply, since a number of commercial supplies and kits are available.

Part C describes the optional VHF scaler. Except for the 50Ω input pot and the HI-LO switch, all of these parts also fit on the main p.c. board, and can be added at any time.

Part D lists the parts for the readouts, with a choice of either Numitron, Minitron, or LED readout. (You could substitute NIXIE® tubes, but then you'll have to redesign the p.c. board since different IC decoder/drivers are needed.) The Numitron

Numitron readouts.

VHF - FM

Solid state modules for VHF and FM Construction. All modules are completely wired and tested for twelve volt negative ground operation. They are constructed on G-10 glass boards using the latest in solid state and IC design. Average size of board is 1½ X 4 inches.

- **RF-144** Single channel front end using two dual gate Mos-fets and two bipolars contains five capacity tuned RF circuits and a netting trimmer across the crystal.
- **RF-220** Same as RF-144 except for 220 MHz use.
- **IF-10.7** A 10.7 MHz IF amplifier with a 455 kHz converter. Contains two ICs, one crystal and five tuned circuits.
- **FM-455** A 455 kHz IF amplifier, limiter, and quadrature detector with two ICs and four tuned circuits. This may be used with any 455 kHz IF Receiver. Narrow band can be made wide band if desired.
- **AS-1** One watt audio amplifier, squelch. Contains two ICs.
- **TX-144** One watt FM exciter with audio limiting, phase modulator, adjustable deviation, and netting trimmer. Contains one IC and four transistors.
- **TX-220** Same as TX-144 except for 220 MHz.
- **PA-144** Ten watt amplifier for above exciter using two power transistors designed for misload protection.
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Prices start at $19.95. With a complete transceiver under $130.00. Circuit boards and parts kits available. Write for prices. Receiver modules $19.95. Transmitter modules $39.95. Power Amp modules $29.95. Complete manual covering all above boards with parts list, layout and schematic $1.00. Prices do not include crystals or shipping. Write for free brochure.

VHF ENGINEERING W2EDN

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readouts mount right on the main board, using 9-pin miniature tube sockets.

Minitron and LED readouts need a separate board to hold the readouts. For the Minitron you can use perf-board with holes on 0.1" centers. The LED readout, however, needs 150Ω current limiting resistors, and so we have designed a 3 x 7 in. p.c. board to hold the five LED readouts, the current limiting resistors, and a single red LED diode for the over-range indicator.

If you use the Numitrons or Minitrons, you will need a separate 3V lamp power supply, as well as a driver transistor for the over-range lamp. Except for the lamp supply power transformer, all other components mount on the main p.c. board.

Finally, part E of the parts list gives some of the miscellaneous parts you will need to complete the counter. As far as the cabinet is concerned, you're on your own. Our prototype (shown in the photos) used a Bud "Tilt-a-View" cabinet (TV-2155) but this cabinet is a lot bigger than you need. We wanted to leave everything open so it would be visible on the photos, but the counter can be crammed into a small cabinet. with the power supply stacked above or below the main board.

Next month we will continue with more information. . . .K2OAW

FREQUENCY COUNTER PARTS LIST

A. Basic counter – less readouts, scaler, power supply

12	SN7490N	TTL decade counters
4	SN7400N	Quad 2-input TTL nand gate
5	SN7475N	Quad TTL latch
5	SN7447N	BCD-to-decimal TTL decoder/driver
2	SN7473N	Dual TTL J-K flip-flop
1	SN7476N	Dual TTL J-K Flip-flop
1	SN7413N	Schmidt trigger TTL
1		10-MHz AT-cut series resonant HC-18/U crystal
1	1.7–14.1	pf variable air capacitor (Johnson 189-505-5
1	40673	RCA dual-gate-protected FET transistor
2	2N5172	NPN transistor or equivalent
1	7 x 10 in.	printed circuit board – see part 3 of article
1	5K	pc mount potentiometer (CTS X-201-R502B or equiv)
2	220Ω	¼ watt 10% resistor
1	560Ω	"
1	1K	"
1	1.8K	"
1	2.2K	"
2	4.7K	"
1	10K	"
1	27K	"
1	100K	"
2	1 Meg	"
1	4.7K	½ watt 10% resistor

THE VANGUARD FREQUENCY SYNTHESIZER

YOU'LL NEVER HAVE TO BUY CRYSTALS AGAIN

MODEL ST-140. Size: 1½" HIGH X 3 5/8" WIDE X 8" LONG. PRICE: $119.95 ppd. NOTE: NY State residents add sales tax.

- 1000 channels from one crystal (yes, that's one thousand) selectable every 10 KHz. from 140.00 to 149.99 MHz.
- Better than .0005% (5 parts per million) from −10° to +60° C down to −30° C with accessory heater available later.
- Thumbwheel switches with digital readout for fast selection.
- Uses a super precision crystal reference source operating at 5 MHz. for easy checking with WWV. RF output is obtained from a VCO tightly locked to the reference source in a digital phase-locked loop circuit.
- Present model is available with output in the 6, 12 or 18 MHz. band (corresponding to 144 MHz.) for direct substitution of transmitting crystals. Built-in computor selects the appropriate frequency when you set the readout to the transmitter output you want.
- Changes frequency almost as fast as you can switch. Settling time is in milliseconds even when switching from one band limit to the other. No hunting or false locks as with some other synthesizers.
- Operates from 10 to 15 VDC. Includes 3 precision IC voltage regulators (one for each major circuit function) to prevent interaction and to take care of those wide voltage swings in mobile installations. Can also be used on 110 volts AC with a small 12 volt 1/2 amp power supply.

COMING SOON: A frequency synthesizer for 45 MHz. receive crystals, a combination transmit and receive synthesizer, a synthesizer with direct output in the 144 and 220 MHz. band, and a whole series of synthesizers to cover from sub-audio to microwave frequencies.

IMPORTANT: When ordering be sure to state if you want the 6, 12 or 18 MHz. output.

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1	33 pF	NPO disk capacitor
2	100 pF	disk capacitors
14	0.01 μF	"
6	0.1 μF	"
450		MOLEX IC socket pins (used instead of IC sockets)
1		SPST switch (Hz-kHz switch)

B. Power Supply

1		Transformer, 6.3V 2 amp and 38V CT 50 mA
2		500 mA 100 PIV rectifier diodes
1		1000 μF 50V electrolytic capacitor
1		SPST on-off switch
1		line cord
1		½ amp fuse and fuse holder
4		2 amp 50 PIV rectifier diodes
1		5000 μF 15V electrolytic capacitor
1		100 μF 15V electrolytic capacitor
1		0.1 μF disk capacitor
1	LM-309K	IC 5V voltage regulator, TO-3 can
1		heat sink for above, minimum 2 x 4 in., finned

C. VHF Scaler (optional)

1	μ6B958259X	Fairchild ECL amplifier IC
1	μ6B95H9059X	Fairchild ECL scaler IC
1	SN7400N	TTL Quad 2-input gate
32		MOLEX pins
1	2N5771	Fairchild PNP switching transistor
7	0.01 μF	disk capacitor
2	0.1 μF	"
1	50Ω	panel-mount carbon pot (Allen-Bradley JA1N056S500MA or equivalent.
1	2K	p.c. mount potentiometer (CTS X-201-R252B or equiv.)
1	120Ω	¼ watt 10% resistor
2	10K	"
2	330	"
6	220	"
1	4.7K	"
1		DPDT switch (HI-LO switch)

D. Readout Indicators – choice of D-1, D-2, or D-3

D-1 Numitron Readouts		
5	DR-2010	RCA Numitrons
5		9-pin p.c. mount tube sockets
1*	5V 30 mA	bulb (Sylvania 5ES8 or equiv) with matching lampholder and lens
1*	6.3V 1 amp	filament transformer (center-tapped)
2*	1 amp 50 PIV	rectifier diodes
1*	10K	¼W 10% resistor
1*	2N5172	NPN transistor or equivalent
D-2 – Minitron indicators		
5		Minitron readouts
5		16-pin IC sockets

Plus all starred components from D-1 above, and a circuit board.

D-3 – Light-emitting-diode readouts		
5	LED	Readouts. (Monsanto MAN-1 or MAN-3, Litronix 10A, Environmental LED-700, or equivalent)
35	150Ω	¼ watt resistor 10%
1		red LED overrange indicator
1	220Ω	¼W 10% resistor
50		MOLEX pins
1	3 x 7 in.	p.c. board for LED readouts

E. Miscellaneous

Cabinet – Input connector – Test leads – Line cord strain relief – Bezel or polarized glass in front of readouts – Hardware.

NOTE: Board layouts are available from the author. Etched and drilled boards are available from Ionic Industries, Criss Circle, Elk Grove Village, IL 60007. Boards, IC's and other parts are available from Circuit Specialists, Box 3047, Scottsdale, AZ 85257: $70 for drilled PC board, IC's and all active devices.

PREAMPLIFIERS

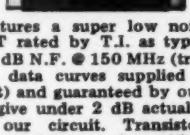
HIGH GAIN • LOW NOISE

35 dB power gain, 2.5—3.0 dB N.F. at 150 MHz, 2 stage, R.F. protected, dual-gate MOSFETS. Manual gain control and provision for AGC. 4-3/8" X 1-7/8" X 1-3/8" aluminum case with BNC receptacles and power switch. Available factory tuned to the frequency of your choice from 5 MHz to 350 MHz with approximately 3% bandwidth. Up to 10% B.W. available on special order.
Model 201 price:
5—200 MHz . . . . . $21.95.
201—350 MHz. $24.95

UHF 3 to 5 dB MAX. N.F. 20 dB MIN. POWER GAIN

The Model 202 uses 2 of T.I.'s super low noise J-FETS in our special circuit board design which gives a minimum of 20 dB power gain at 450 MHz. Stability is such that you can have mismatched loads without it oscillating and you can retune (using the capped openings in the case) over a 15—20 MHz range simply by peaking for maximum signal. Available tuned to the frequency of your choice between 300—475 MHz. 4-3/8" X 1-7/8" X 1-3/8" aluminum case with BNC receptacles and power switch.
Model 202 price: . . . . . $31.95.

LESS THAN 2 dB N.F. GAIN: 20 dB @ 150 MHz. SIZE: 2¼" X 5/8 X 1"



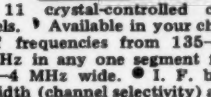
Features a super low noise J-FET rated by T.I. as typically 1.2 dB N.F. @ 150 MHz (transistor data curves supplied with unit) and guaranteed by our lab to give under 2 dB actual N.F. in our circuit. Transistor is mounted in a socket with gold plated contacts. 4 precision trimmers make possible tuning for optimum desired results over a wide range of conditions. We supply it tuned for minimum noise figure across 50 ohms input and output resistance. Fully shielded in aluminum case with feed-thru solder terminals. Supplied with mounting kit for installing inside or outside your receiver. Tuned to the frequency of your choice from 135 MHz to 250 MHz with approximately 2—4 MHz bandwidth.
Model 102 price: . . . . . $19.95.

CONVERTERS

40 dB GAIN 2.5—3.0 N.F. @ 150 MHz

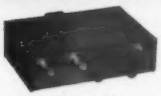
2 RF stages with transient protected dual-gate MOSFETS give this converter the high gain and low noise you need for receiving very weak signals. The mixer stage is also a dual-gate MOSFET as it greatly reduces spurious mixing products — some by as much as 100 dB over that obtained with bipolar mixers. A bipolar oscillator using 3rd or 5th overtone plug-in crystals is followed by a harmonic bandpass filter, and where necessary an additional amplifier is used to assure the correct amount of drive to the mixer. Available in your choice of input frequencies from 5—350 MHz and with any output you choose within this range. The usable bandwidth is approx. 3% of the input frequency with a maximum of 4 MHz. Wider bandwidths are available on special order. Although any frequency combination is possible (including converting up) best results are obtained if you choose an output frequency not more than 1/3 nor less than 1/20 of the input frequency. Enclosed in a 4-3/8" X 3" X 1-1/4" aluminum case with BNC receptacles, power and antenna transfer switch.
Model 407 price:
5—200 MHz . . . . . $42.95.
201—350 MHz. $44.95
Prices include .005% crystal. Additional crystals $5.95 ea.

VHF FM RECEIVER 11 CHANNELS • 135—250 MHz



• 11 crystal-controlled channels. • Available in your choice of frequencies from 135—250 MHz in any one segment from 1—4 MHz wide. • I. F. bandwidth (channel selectivity) available in your choice of +/— 7.5 kHz or +/— 15 kHz. • 8-pole quartz filter and a 4-pole ceramic filter gives more than 80 dB rejection at 2X channel bandwidth. • Frequency trimmers for each crystal. • .2 to .3 μvolt for 20 dB quieting. • Dual-gate MOSFETS and integrated circuits. • Self-contained speaker and external speaker jack. • Mobile mount and tilt stand • Anodized alum. Case, 6" X 7" X 1 3/8".
Model FMR-250-11 price:
135—180 MHZ. $109.95
181—250 MHz $119.95
Price includes one .001% crystal. Additional crystals $6.95 ea.

UHF 20 dB MIN. GAIN 3 to 5 dB MAX. N.F.



This model is similar in appearance to our Model 407 but uses 2 low noise J-FETS in our specially designed RF stage which is tuned with high-Q miniature trimmers. The mixer is a special dual-gate MOSFET made by RCA to meet our requirements. The oscillator uses 5th overtone crystals to reduce spurious responses and make possible fewer multipliers in the oscillator chain which uses 1200 MHz bipolars for maximum efficiency. Available with your choice of input frequencies from 300—475 MHz and output frequencies from 14—220 MHz. Usable bandwidth is about 1% of the input frequency but can be easily retuned to cover more. This model is now in use in many sophisticated applications such as a component of a communications link for rocket launchings.
Model 408 price: $51.95
.005% crystal included.

NOTES

All preamps on this page are for operation on 12 VDC and draw approximately 5 to 20 ma. Available for 6 volts on special order. Stated dB gain figures are for power gain across 50 ohms input and output load resistance.
All converters and receivers on this page are for operation on 12 VDC. Still available are our FMR-150-A at $89.95 and a line of frequency scalers starting at $99.50.

HOW TO ORDER:

State model, input and output frequencies and bandwidth where applicable. Remit in full, including sales tax if you reside in N.Y. State, direct to Vanguard Labs. Prices include postage by regular parcel post. For air mail or special delivery include extra amount; excess will be refunded.

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EXTRA!

OSCAR MARINER ONE IS ON THE PLANET MARS

by Keith E. Lamonica W7DXX, special to 73 Magazine

Well it took a long time but OSCAR Mariner 1 is now on the planet Mars and operating well. As you recall, space became available for the OSCAR package on the last unmanned NASA mission to Mars. Dr. Bernard Wizenhoff called OSCAR headquarters and told the group the good news. He said, "Gentlemen, we are launching Mariner 34 to the planet Mars when the next launch window is available for the shot. It will be between January 11 and 18th. We will place three Bromar type capsules in synchronous orbits around the planet and an LSVL (Life Support Verification Lab) on the planet's surface near the Nodus Gordii crater complex." Dr. Wizenhoff continued, "We have room for a 12-pound package from the OSCAR boys."

Dr. Wizenhoff and NASA had given amateurs around the world a chance to study Mars. However, a great deal of work had to be completed in a short period of six months. It had been hinted three years ago that space on a Mariner mission would become available so a great deal of thought had been put into a possible OSCAR mission to Mars. These were to be the main objectives of OSCAR Mariner 1:

1. The capsule would have a 450 MHz beacon transmitter on 444.1
2. The capsule would have a 1250 MHz to 144.1 repeater
3. The capsule would incorporate a general coverage receiver that would automatically scan from 500 kHz to 10 MHz and retransmit any signals found to 1250 MHz
4. The capsule would make use of a small atomic generator donated to OSCAR by NASA.
5. The capsule would transmit slow scan video signals during approach, descent, and after landing on Mars.

This was to be an extremely ambitious program that looked good on paper and would now be put to the test. OSCAR Mariner 1 had to be designed, built, and ready for launch in *six months*.

Howard W6UOV and his group would concentrate on the 450 beacon and 1250 to 144 repeater. The boys at OSCAR in Europe would design and build the general coverage receiver with auto scan. The engineers at NASA agreed to install the atomic powered generator and television camera. We were informed that the television camera would be on loan only. I can't figure out how they intended to get it back since all manned flights to Mars had been cancelled after the strange goings on with the manned Mariner 16 and 21 missions. As you recall, NASA cancelled all manned flights to the surface until a more complete study could be made of the strange lights and mental confusion. The crew of Mariner 16 had an excellent flight to Mars and everything went very well until their first rest period while in a parking orbit around the planet. The crew was awakened from their rest period by strange pulsating lights coming from the outermost moon of Mars, Demos. Although the crew claimed it looked like a sort of code, NASA claimed the lights were some form of natural phenomona (maybe swamp gas). The lights stopped after about 3 hours and the crew prepared to leave their parking orbit and land on the planet Mars. When the crew landed near the Nodus Gordii crater complex they were met with what they could only describe as "mental confusion." As one crew member described it: "As soon as we touched down it was like opening a door to hell. My mind was going in circles. I had trained for years for this mission. I had my list of objectives and sequence of events firmly planted in my mind but as soon as we hit the planet, all I could think of was how fast I could get out of here."

Well, we all know how the mission ended. After 3 hours on the surface of Mars the crew took off and returned to earth. The official NASA explanation was that "due to the great strain of many weeks in space in a weightless condition the crew suffered mental breakdown when they approached Mars."

Anyway, back to OSCAR. Since none of the previous unmanned missions to Mars had met with any difficulty, other than camera failure on most missions, it was decided to incorporate as much scientific equipment into the OSCAR capsule as possible.

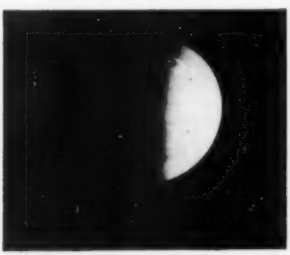

Photo 1

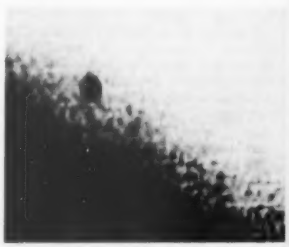

Photo 2

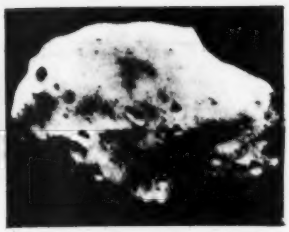

Photo 3

Through extraordinary cooperation and many sleepless nights in the building of OSCAR Mariner 1, he was ready for a checkout one week ahead of schedule. The entire package was installed aboard a twin engine Comanche aircraft and flown around the southern California area. OSCAR worked well, relaying pictures of the ground below while sending out the 450 beacon and repeating 1250 MHz to two meters and sending out telemetry data on environmental conditionn (we did not include a smog detector for southern California). The only problem with OSCAR turned out to be minor. The 450 MHz beacon was shifting in frequency and the power was down. The problem with the beacon was so minor that it was repaired while in the aircraft. OSCAR Mariner 1 was ready to meet Mars.

After several days of frustrating "holds" at the Cape, a Thor Monarch combination blasted OSCAR toward space.

After several months in space OSCAR was approaching Mars. While inside the main rocket, OSCAR was controlled through NASA. All commands and telemetry were received and relayed through the big NASA 'dishes" around the world. Three hundred thousand miles from Mars OSCAR was given the command to turn on the camera and telemetry transmitter. Back came a strong signal indicating OSCAR was well and that pictures were being taken of Mars. It would be 15 minutes before we would see the first pictures from OSCAR since the slow scan television camera records the pictures on tape and then sends each complete set at once. The 15 minutes dragged on until finally the 1250 carrier appeared indicating a picture was about to be sent. However, all we heard was the carrier – no pictures. A command was sent to OSCAR to send back a status report. Evidently the on-board computer had become confused and erased the pictures before they were sent. Normally, after each picture series is sent back, the ground crew sends a command to OSCAR which in effect says, "We received the last set of pictures. Now erase your tape and start recording a new set of pictures." Anyway, the computer was confused and got the sequence out of order.

A new command was sent to take a new series of pictures and not erase the damn things this time. After another agonizing 15 minutes passed, the big screen at NASA came to life and the first picture from OSCAR started to take form. Slowly the picture took form as the tape played back the picture frame by frame. What started as a couple of white lines across the top of the screen turned into a large white ball – the planet Mars. After computer enhancement picture one shows the planet Mars from a distance of 300,000 miles. A great first for amateur radio operators around the world. The picture shows Mars during one of the planet's dust storms. During these storms wind velocity exceeds *500 mph*.

As OSCAR approached the red planet and went into a parking orbit more pictures were taken. Picture 2 is rather spectacular. The dark spot in the lower right hand corner of the picture is the innermost moon of Mars, Phobos, as it crossed the planet's surface. Several pictures were taken of Phobos. Picture 3 shows it to be a very old and rugged moon. In the upper corner of the picture you can see where part of the moon has been torn away – probably due to an impact with a large meteor.

As OSCAR left the parking orbit for a ride down to the surface of Mars, the cameras were rolling. In a series of pictures during the approach (pictures 4, 5, 6, and 7) one can see the polar ice caps of Mars and many of the larger Martian craters. Picture 8 shows the landing spot of OSCAR. This picture taken a few minutes before touch down shows the Nodus Gordii crater complex and an "X" marks the actual point of touch down.

Photo 8

After impact OSCAR was commanded to extend his antennas and all equipment, which he did beautifully. Now instead of having to be relayed through NASA, OSCAR's signals were coming directly from Mars to Earth. The first signals were very strong – in fact somewhat better than those relayed through NASA. Immediately OSCAR began transmitting the 450 MHz beacon, repeating 1250 MHz to 144.1, and scanning the planet for signals in the 500 kHz to 10 MHz range and retransmitting them back to Earth. Signals from the 1250 to 144.1 repeater were strong and steady. Hundreds of Earthside amateurs were communicating via a repeater on Mars. The activity was so immense that Wayne Green W2NSD/1 immediately suggested we split the channels into 600 kHz segments. The repeater is broad band allowing twenty-five to thirty conversations at one time.

At this time, no other pictures have been received from OSCAR. Somehow the computer on board is pulling its old trick of erasing the pictures before they are sent. The repeater is going well, as is the LSVL system. All systems have a life expectancy of at least one year. The LSVL system reports back that Mars is much friendlier than we at first thought.

OSCAR tells us that the atmosphere of Mars can possibly support life as we know it . . .

Photos 4, 5, 6 and 7

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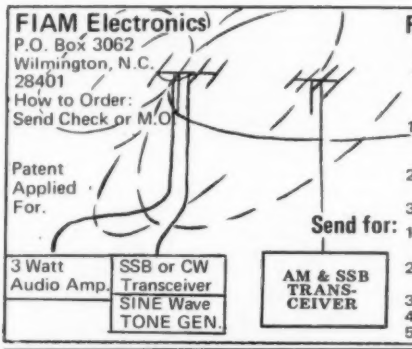

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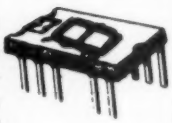

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Although Newtronics supplies their resonator tip rods with a "split pea" type of marker (which you move to mark your favorite frequency) this is good for one setting only. What if you want to mark the whole band, every 100 kHz, or for two cars (which never seems to fall at the same setting of the resonators)?

My solution was simple . . . after finding the point of resonance, I filed a small notch into the tip rod, with the edge of a file. A slight notch on one side of the rod is easily spotted, and in no way hampers operation of the resonator.

My 40 meter resonator, which has notches for car No. 1, car No. 2, CW, mid-band, and phone portions, somewhat resembles Jesse James' gun handle, but I can move from car to car, or from phone to CW without worrying about swr, and know my signal is at its best.

A word of caution – keep a list in the glove compartment of which notches are for what frequency, lest you have to get out the trusty swr bridge and go over it again.

This system, while used on my "Hustlers," would work just as well on any of similar antennas.

. . .K4TWJ

INTEGRATED CIRCUIT TV SYNC GENERATOR

Claude Wiatrowski K9AAC/7
3401 N. Columbus Blvd.
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The prices of both digital and linear integrated circuits have fallen so quickly in the past few years that it now costs more to build certain electronic systems from discrete components than to buy the equivalent integrated circuit. This article describes just such a case: the use of digital integrated circuits in a synchronizing generator for an amateur television station. This is not the usual sync generator probably found in the majority of amateur television stations. It generates the same sort of synchronizing, blanking, and drive signals that commercial television stations generate. Equivalent sync generators using vacuum tubes are found in commercial stations to this day. They are notoriously unstable, difficult to adjust, consume upwards of 450 watts of power, and may fill one or two large relay racks. The integrated circuit version described in this article is extremely stable, has only five easily set independent adjustments, consumes a little over one watt of power, and will fit behind a standard rack panel. More remarkable is the fact that the total cost of the unit is under fifty dollars.

Now, if you are interested in contructing a sync generator, I will assume that you have

some experience in television systems. For those of you interested in the theory of the unit, I will also assume you have a familiarity with basic digital circuits and logic.

The blanking signal generated by this unit is identical to the signal all television stations, both amateur and commercial, use for this purpose. The sync signal generated, used by all commercial stations and very few amateur stations, may not be familiar to the amateur television operator so a short explanation is in order.

The Synchronizing Signal

Many simple camera designs that have been published in amateur journals rely on the blanking signal to synchronize the scanning oscillation in the receiving television. A more sophisticated approach is to add separate sync pulses on top of the blanking pulses while establishing a definite time relationship between the line and field frequencies, a truly interlaced system, as opposed to random interlace. Note, however, that in both systems the horizontal scanning oscillator of the receiving television will not be synchronized during the vertical sync pulse.

In order to achieve accurate interlace, it is imperative that the horizontal oscillator remain synchronized at all times. To accomplish this, the vertical sync pulse is serrated at twice the horizontal rate. The sync separator in a television receiver consists of a differentiator and an integrator. The output of the differentiator is a series of very short pulses corresponding to the edges of the synchronizing pulses. Since the widths of the pulses have no effect on the differentiator output, its output remains the same through the vertical sync interval due to the extra edges on the serrated vertical. It is this output that keeps the horizontal scanning oscillator synchronized at all times.

The integrator, on the other hand, responds to the widths of the pulses. The output of the integrator is roughly the average over an interval of time of the area of the pulse train. Indeed, then the output of the integrator increases as the pulses become wider and decreases as the pulses become narrower.

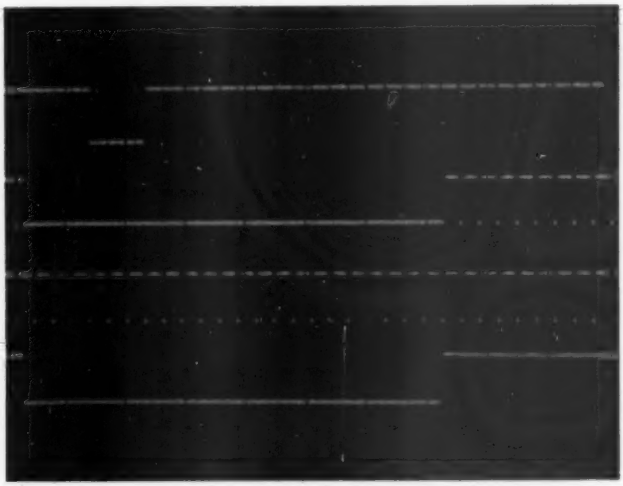

Fig. 1. Scope trace photo of sync and blanking signals and horizontal and vertical drive.

Since the vertical sync pulses are wide compared to the horizontal pulses, the output of the integrator corresponds to the vertical sync pulse interval. It is this output that synchronizes the vertical scanning oscillator.

Because every other field ends on a half line, the last horizontal sync pulse will vary

in position relative to the vertical pulse by 31.75 μs. This will cause the output of the integrator to be shifted by a small amount on alternate fields. This shift is enough to cause the lines on alternate fields to pair rather than be spaced equally. The group of pulses that remedy this situation are called equalizing pulses.

Six pulses, each of half the area and twice the repetition rate of the horizontal pulses, are placed before and after the vertical sync pulses. Being the same on every field, they serve to buffer the integrator output against shifts of the horizontal sync pulses which now occur farther away in time.

The complete sync, blanking, and drive signals are shown in **Fig. 1.** This has not been intended as a rigorous treatment of the television synchronizing system. For the interested reader, the subject is covered in many texts.

All gates are negative logic *nand* or positive logic *nor.* As this unit was designed with negative logic in mind, the analysis proceeds most easily from this viewpoint.

The flip-flops toggle on the negative-going edge of a trigger (T) pulse provided the set (S) and clear (C) terminals are left floating or are grounded. A signal of +3V on the set and 0V on the clear will cause the flip-flop to set on a negative-going trigger edge. (Set is interpreted as meaning terminal Q in the drawings will go to +3V and terminal $\bar{Q}$ will go the 0V.) An analogous situation exists for the clear input and the reset condition of the flip-flop. These flip-flops also have a dc clear which resets the flip-flop on a 3V pulse or level which overrides the inputs on all other terminals.

The Clock and Frequency Dividers

Basic components of any accurately interlaced scanning system are frequency dividers. One frequency divider divides the input frequency of 31.5 kHz by 525 to obtain a signal at the field rate of 60 Hz. Another unit divides by two to obtain 15.75 kHz, the line rate. In the sync generator described in this article, the dividers are actually electronic binary counters requiring no adjustments. The simplest of all these circuits will divide only by powers of two. An example is the 4:1 counter of Fig. 2 used to obtain a 31.5 kHz signal from a 126 kHz oscillator. It is necessary to apply feedback to count by numbers other than a power of two. The 15:1, 7:1, and 5:1 counters that make up the 525:1 divider in Fig. 2 are examples of this type of counter. Briefly stated, the output of the *nand* gate associated with each counter resets the entire counter to zero when the required count is reached.

The 7:1 counter has some minor variations. The last stage is reset by the action of the previous stage resetting. A capacitor is placed across the input of this counter.

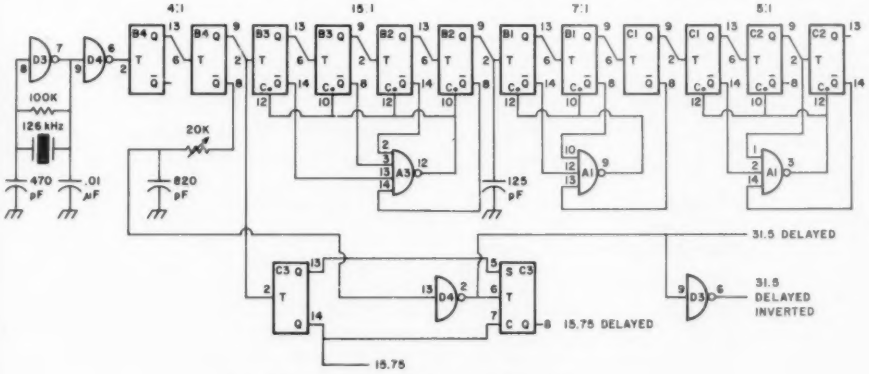

Fig. 2. Master oscillator frequency dividers.

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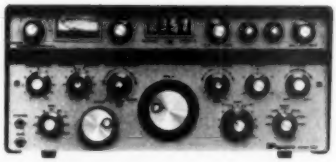

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These two modifications are necessary to prevent extraneous pulses from resetting or triggering the counter stages. This is fast logic and the offending pulses are less than 1V in magnitude and 50 ns in length.

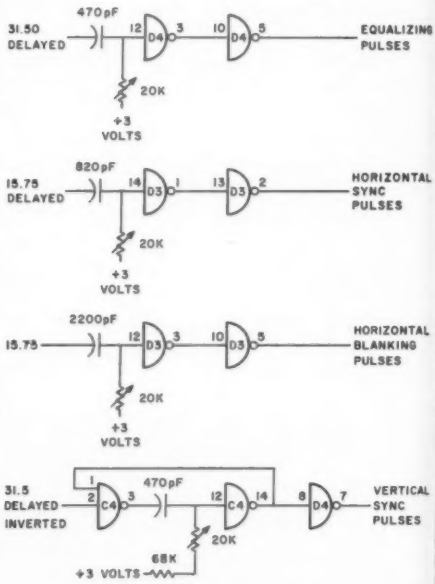


Fig. 3. Pulse generation.

There are two separate 2:1 counters. One counter is triggered by a signal delayed by an inverter and RC circuit connected to its input. The connections from the outputs of the nondelayed counter to the set and clear inputs of the delayed counter keep the two counters in phase. Without these connections it would be possible for the sync pulses to appear between rather than on top of the blanking pulses The delayed outputs are used to trigger all basic pulses except the horizontal blanking pulses. This delay which is adjusted to 1.27 μs accounts for the space between the leading edge of the blanking pulse and the leading edge of the sync pulse (sometimes called the front porch).

The delay is accomplished as follows. Assume that the input of inverter D4 is initially at 0V and its output is at 3V. If the input voltage to the potentiometer suddenly rises to 3V, the capacitor will only slowly

change to 3V. The rate of change is adjusted by the potentiometer so the input to the inverter rises to the point necessary to saturate the transistor in the inverter after 1.27 μs. Thus, 1.27 μs after the input transition takes place, the output transition will take place from 3V to 0V.

The master oscillator operates at 126 kHz. This frequency was chosen because crystals for this frequency are less expensive and more easily obtained than lower frequency crystals. The circuit is a Pierce oscillator constructed from a digital inverter. A second inverter is used to shape the output to trigger the 4:1 divider to 31.5 kHz. The 0.01 μF phase-shifting capacitor may have to be increased for a lower Q crystal. It is also possible for this circuit to oscillate at a harmonic of 126 kHz. The cure here also is to increase the value of the capacitor.

Pulse Generation

Four monostable multivibrators are used to generate the following pulses: equalizing pulses, 2.54 μs; horizontal sync pulses, 5.08 μs; horizontal blanking pulses, 10.16 μs; and vertical sync pulses, 27.31 μs.

The 27.31 μs monostable is a standard design contructed from two gates. The other monostables are constructed from one inverter each. They are not true monostables in the sense that they do not have feedback.

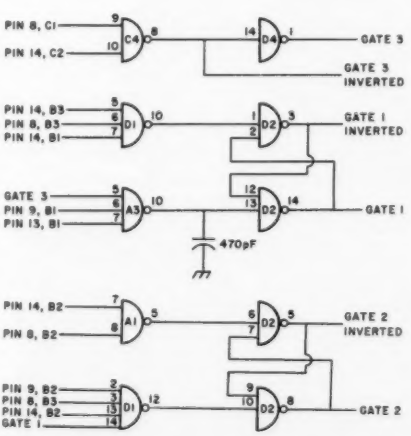


Fig. 4. Gate generation.

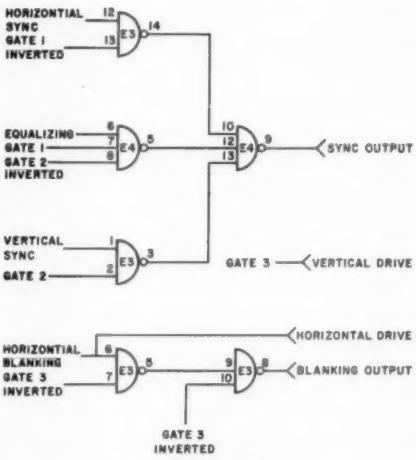


Fig. 5. Output gating.

They will work in this application because the half period of the driving waveform is longer than the resquired pulse width. The circuitry is shown in Fig. 3. All outputs are inverted.

Generating the Gating Signals

The main counter has 525 unique states of each of its flip-flops. These states can be decoded to provide gating signals.

Gate 3 is the vertical blanking signal. It is generated directly as a combination of the states of two flip-flops of the counter. This gate is about 3 horizontal lines longer than the recommended width. This is virtually unnoticeable and the additional logic necessary to correct it hardly seems worth the additional complication and expense.

Gate 1 gates off the horizontal sync pulses and gates on the equalizing pulses. Gate 2 gates off the equalizing pulses and gates on the vertical sync pulses. Gates 1 and 2 are both produced by gating pulses from the main counter at the beginning and end of the gate times and using these pulses to set and clear flip-flops made of two cross connected *nand* gates. The circuitry is shown in Fig. 4.

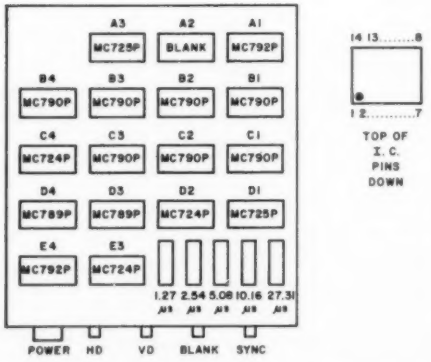
Output Gating

Gates 1, 2, and 3 are used to turn off and on the basic pulses at the required times.

Gate 3 (Fig. 5) gates off the horizontal blanking pulses during the vertical blanking interval and it itself is inserted as the vertical blanking signal.

Possible Changes

It is possible to generate "on" and "off" pulses and use these to set and clear a flip-flop to generate gate 3 analogous to the circuits for generating gates 1 and 2. In amateur service this additional circuitry hardly seems worth the additional cost and complication. If the unit is intended for commercial service, this modification will be necessary. Other modifications that would normally be required for commercial service would be separate width and position flip-flops and associated gating for the vertical and horizontal drive signals. Another "must"



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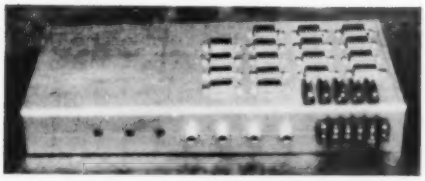

Fig. 6. The completed sync generator.

is the inclusion of alternative methods of master frequency control, such as a method to lock the generator to the power line or some external source (such as network or remote site sync generator).

Construction

The unit is constructed on a 6 x 12 in. chassis of which only 6 x 7 in. is used for the sync generator (Fig. 6). The primary consideration to bear in mind is ease of wiring. Each integrated circuit has a possible fourteen or more connections to it and space for wiring can be rapidly depleted. This unit could ideally be constructed on a single printed circuit card, although the layout of such a large printed circuit is not a simple task.

On all integrated circuit sockets, pin 4 is ground and pin 11 is connected to +3.6V. The crystal socket was mounted on a bracket on the underside of the chassis. All discrete components were mounted on a directly on the IC sockets. I do not recommend this procedure as it makes an already crowded situation worse. A possible improvement would be to mount all discrete components on a piece of Vector board mounted on the underside of the chassis.

The multiturn potentiometers are a convenience but satisfactory operation should be possible with ordinary carbon potentiometers. Four phone sockets are used for sync, blanking, and vertical and horizontal drive connections.

The large empty space on the chassis, the extra output connectors, and the two spare terminals on the power block are for possible expansion to color. The IC socket is a 16-pin type that works as well for these 14-pin packages.

Adjustment Procedure

Assuming that you prefer to wire and test the generator in sections, the first section to be wired should be the clock and frequency dividers. Observe the input and output of the 15:1 divider on a dual-trace oscilloscope. There should be 15 input pulses for every output pulse. If you do not have dual-trace facilities, you can mix the two signals in a spare gate. Although the output does not look the same as with a dual-trace scope, the number of pulses that should occur *during the output pulse* for each counter can be determined from Fig. 7, which shows scope trace photos of the gating and counting circuits. The other dividers may be checked in the same way.

See that the 15.75 kHz and delayed 15.75 kHz signals are in phase. They will be if you have not made a wiring error. Adjust

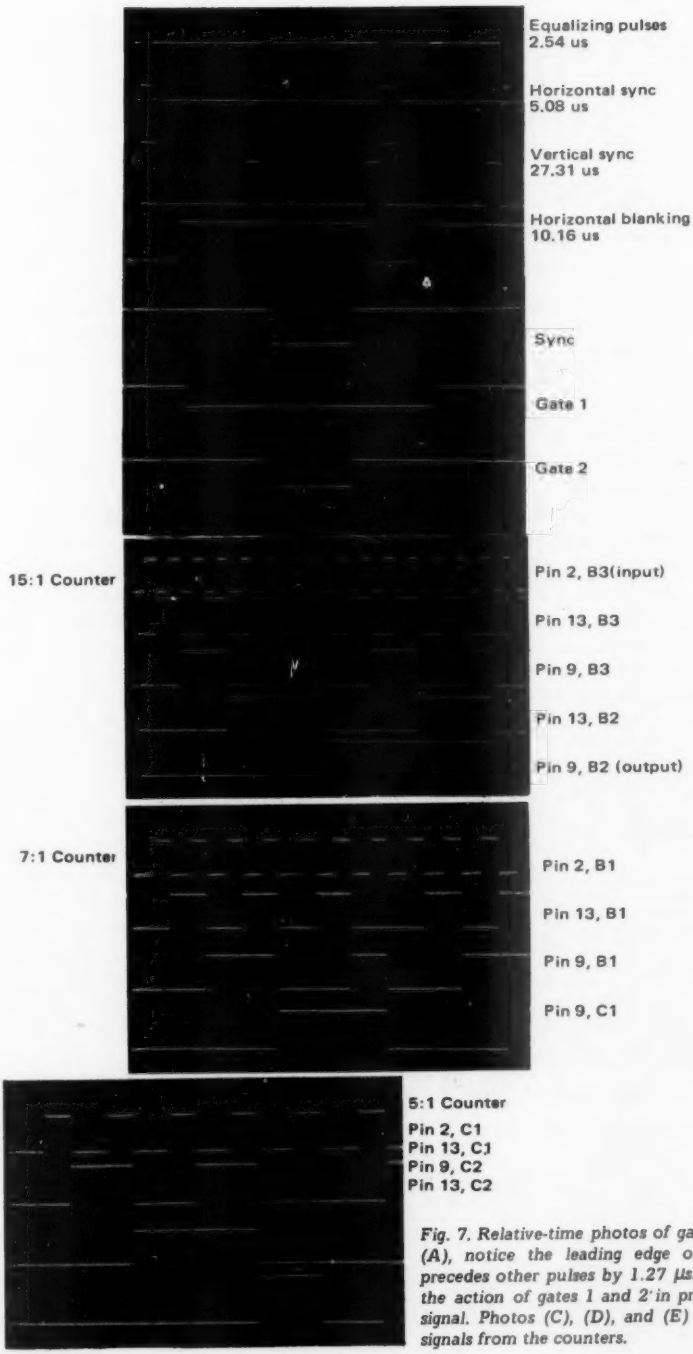

Fig. 7. Relative-time photos of gating functions. In (A), notice the leading edge of blanking pulse precedes other pulses by 1.27 μs. Photo (B) shows the action of gates 1 and 2 in producing the sync signal. Photos (C), (D), and (E) show the output signals from the counters.

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the delay so that there is a 1.27 μs between the leading edges of the two signals. Again, without a dual-trace oscilloscope, mix the *inverted* nondelayed output with the normal delayed output. The pulse on the oscilloscope from the output of your mixing gate has a width equal to the delay time.

Since the outputs of this unit are the outputs of gates, they *will not* drive a low impedance load. All inputs to other equipment should be high impedance and the line should *not* be terminated with a resistor. This situation is ideal in my station as most equipment is of IC contruction and the output of the sync generator simply drives other gates. If you absolutely require low impedance signals, the outputs of the gates may be buffered with simple emitter followers.

Wire the monostables and their inverters next. Look at the output of the inverters and adjust the pulse widths to the correct values. Remember the pulses are negative going at the outputs of the inverters. Wire gate 3 first, then gate 1, and finally gate 2. The outputs of the three gates may be compared with the scope pictures in Fig. 7. Their widths should be: gate 1, 571.5 μs; gate 2, 190.5 μs; gate 3, 2857.5 μs. Lastly, wire the output gating and connect it all together. Sync, blanking, and drive should now appear at their respective output terminals. Check the appearance of the blanking and drive with an oscilloscope. The sync waveform may only be viewed reliably using an oscilloscope with delaying sweep. The delay has to be longer than two fields, as the horizontal sync pulses alternate their position every other field. Without these precautions you can not be certain that your scope trace is an accurate indication of the output waveform. Note, however, that *no* adjustments *have* to be made while looking at this waveform so if you trust your wiring and previous adjustment procedure, you can be confident of having a correct sync signal. If you still insist on seeing the sync waveform, it is possible to add a single flip-flop as a 2:1 counter connected to the output of this 2:1 divider to the external sync on your scope and you should be able, after some adjustment, to see the sync signal. . . . K9AAC/7 ■

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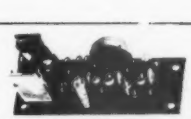

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An Introduction to a Science

Radio Astronomy and Amateur Radio

Osler H. Johns, Jr. W4ZBE
114 Rollins St.
Orlando, Fla. 32804

For a quarter of a million years, since man first stood erect on his hind legs, he has gazed with wonderment into the mysterious universe using only his eyes to receive the tiny bits of light energy arriving from the distant parts of space.

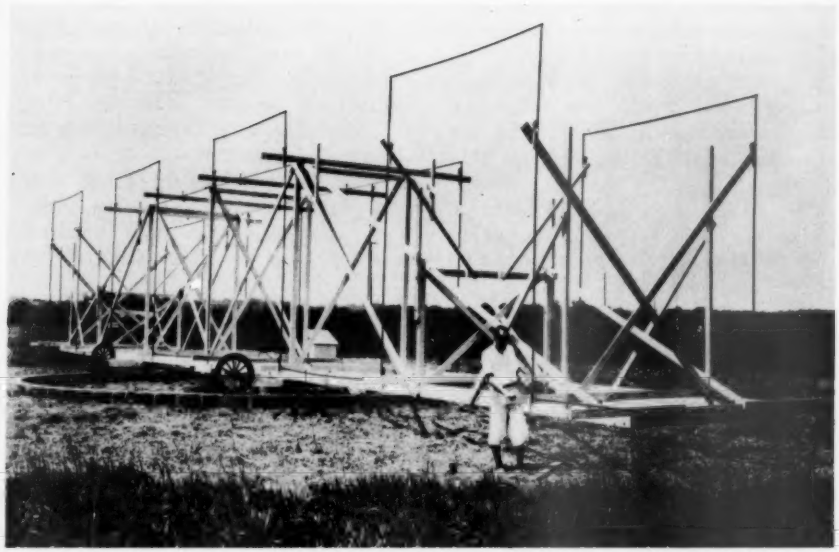
In the last one hundredth of one percent of time, in the history of mankind, man has used devices to aid his visual observation of the universe. The refracting telescope by Galileo was the first.

Only in the last one thousandth of one percent of mankind's lifespan has man been aware of energy other than light arriving at his planet. In fact, serious concentrated work in these fields has been taking place for less than 25 years.

Karl Jansky. In 1931 Bell Telephone Labs assigned a young engineer named Karl Jansky to investigate the problems involved with transoceanic radio interference. Lightning discharges, aurora, and the unknown way in which radio waves skipped off of the ionosphere combined to make for serious problems in long-range radio communications.

In order to monitor interference noise the young engineer built a large steerable antenna with, for the time, a very sensitive receiver. The antenna was 100 ft long and could be rotated 360 degrees to act as a direction finder. A frequency of 20.5 MHz was selected — a frequency well above that commonly used for broadcasting and communications in 1931.

Jansky's experiments detected a noise of a strange nature. The noise was of a continuous type rather than the erratic type associated with most types of radio interference originating within the atmo-



A historic photo of the late Karl G. Jansky of Bell Telephone Laboratories with the rotating antenna he used to discover radio waves coming from space. Mr. Jansky's investigations during the 1930s into the causes of strange noise in telephone equipment resulted in the discovery of radiation noise from the center of the Milky Way and gave the world a new science – radio astronomy. (Bell Labs.)

sphere. The noise was relatively strong and displayed the interesting property of starting 4 minutes earlier each day.

Karl Jansky himself correctly theorized that the noise must be originating from extraterrestrial sources in the galaxy.

During the next two years the Bell Labs engineer continued to study this extraterrestrial hiss. It was discovered by Jansky that the signal level was highest in the direction of the center of our own galaxy. He published his findings in professional journals during the years 1932 to 1935.

After 1935 the Bell Telephone Labs transferred Jansky to another research project not connected with radio noise from space.

Grote Reber (W9GFZ). Jansky did not follow up on radio astronomy after making his initial discoveries. His interests lay principally with radio communications and not with astronomy.

Grote Reber, a professional electrical engineer and avid amateur radio operator had read all of Karl Jansky's papers on extraterrestrial noise. As an amateur radio operator he had contacted other "hams" on all continents and in every state using equipment he built himself.

Reber, all on his own and in his own back yard, constructed a 31 ft parabolic dish antenna, and a receiver capable of receiving signals at 3300 MHz.

In 1937, this in itself was quite an amazing accomplishment. The frequency picked was twenty times higher than any frequency being used during the mid-1930s. It must be remembered that this was years before radar or microwave communications came into use. Dish antennas and microwave receivers were very rare indeed.

The equipment worked but no noise was received, so Reber decided to come down to a frequency of 910 MHz. Again no astronomical noise was received so Reber again decided to come down to a still lower frequency of 160 MHz.

By 1939 the diligent amateur had succeeded in receiving radio noise from several sources; however, astronomers of 1939–40 were reluctant to give complete support to

some of Reber's findings because radio wave radiation did not always correspond to optical astronomy findings.

In 1944 Reber published the first radio sky map; a map of excellent professional quality considering it was made by one enterprising amateur using all home built equipment.

An interesting method was used in making this radio sky map. Because of economy, Reber's telescope was not built to be steerable in azimuth but only in declination. For this reason Reber would position the antenna at one point of declination. The next night the antenna would be plunged a few more degrees. The next night the dish would be plunged several more degrees, and so on each night for the complete travel of the antenna in declination. Each night the sky would sweep past the antenna for each position of declination, thus after several nights the entire sky could be effectively mapped.

From the mid-1930s until after WWII there was only one radio astronomer – Grote Reber. Reber is still working as a scientist for the ESSA department of the U.S. Government; his major interest is with radio wave propagation.

World War II brought about many advances in the state of radio communications and radar. The most important advances were in highly sensitive high frequency and microwave receivers and in highly directional antennas. After the war, these advances in radio technology were put to use in the building of radio telescopes.

The late Karl Jansky of Bell Telephone Laboratories is shown pointing to the position on a chart where radio noises from space were first heard. While attempting to pinpoint the source of noise interfering with radiotelephone service, Jansky detected a peculiar hissing sound coming from the area of the Milky Way. Later this hissing was identified as radio signals generated by the natural processes in stars and galaxies. His work resulted in the new science of radio astronomy, in which the heavens are studied by listening to radio waves rather than looking through an optical telescope. (Bell Labs.)

One famous astronomer who decided to concentrate his efforts in the field of radio astronomy was an Englishman named Sir Bernard Lovell. Lovell is the director of the Jodrell Band Experimental Station. At Jodrell Band the first really large, fully

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steerable radio telescope was assembled. The dish antenna was a monster of some 250 ft in diameter, but it could be aimed at almost any point in the sky with great precision! For some time the reflector was the largest radio telescope in the world.

NRAO. By the early 1950s it became obvious that if serious work was to be accomplished using radio telescopes very large and very expensive instruments would have to be built. Such undertakings would require federal financial support because of the enormous cost of the equipment.

By the middle 1950s scientists interested in radio astronomical research had requested the National Science Foundation to construct a national radio astronomy observatory.

Green Bank, West Virginia, was chosen because of its remote location far from man-made electrical interference; the mountains surrounding the location acted as a shield; and a large expanse of available well-suited land became the choice for the national radio observatory.

Grote Reber (W9GFZ) the world's only radio astronomer from the late 1930s until after World War II. During the 1930s Reber constructed, on his own, a highly sensitive receiver operating in the microwave and UHF regions and utilizing a 31 ft dish antenna. He both constructed and designed his equipment and interpreted its findings. Without question, this man will be considered one of the giants in amateur radio circles in years to come. (National Radio Astronomy Observatory.)

The largest equatorially mounted telescope in the world (optical or radio) is the 140 ft dish operated by the NRAO at Green Bank, West Virginia. A single bearing supports the entire 2500-ton structure. This bearing is polished to a tolerance of 3 mils and floated in a 5-mil layer of oil. Such precision allows the great instrument to be pointed at any direction of the sky with extreme accuracy. The receiver is normally used at wavelengths shorter than 2 cm, or 15,000 MHz. The telescope took seven years to design and build and cost $14 million. (National Radio Astronomy Observatory.)

The complex of telescopes erected in the West Virginia mountains near Green Bank makes it the world's most versatile radio observatory.

The instruments include a 300 ft telescope which is the world's largest movable telescope; a 140 ft telescope with a very precise reflecting surface; and three 85 ft telescopes used in conjunction with each other. This array allows the three telescopes to in effect act as one telescope 5000 ft long. A portable 42 ft telescope rounds out the collection of instruments. The portable telescope allows the astronomer to extend the base line of the three permanent 85 ft telescopes, thus making a telescope which in effect is even longer than 5000 ft.

The engineers and scientists at Green Bank are already at work on an even more ambitious project. This new telescope would actually be an array of many separate antennas spread over a 26-mile area and feeding a single receiver. This would in effect make for an antenna that would be 26 miles in diameter. This 26-mile telescope has been aptly called the VLA (for "very large array").

University of Florida. The astronomy and physics department of the University of Florida at Gainsville, Florida, for many years has been doing research on radio waves arriving from noise sources within the solar system. The frequency used for listening is far below the frequencies usually employed in radio astronomy work. As a matter of fact the frequency is very close to that used by Karl Jansky in his original work.

Jansky, however, never received radio radiation from individual planets. If he did receive noise from planets he was not aware of it because of the poor resolution of his antenna system.

Much original knowledge about planetary astronomy has come from the University of Florida; of particular interest has been the planet Jupiter's relatively strong radiation.

Professors Alex G. Smith and Thomas D. Carr of the University of Florida have been particularly active in high frequency planetary radio astronomy.

Arecibo. No history of radio astronomy would be complete without including the giant telescope at Arecibo, Puerto Rico.

This huge telescope was the brainchild of Professor William E. Gorden of Cornell University.

The dimensions are truly staggering: 1000 ft in diameter; 500 ft deep; and a 500-ton feedhorn that is 200 ft long.

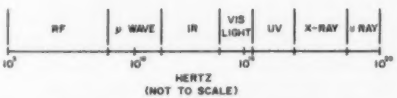

Fig. 1. Plot of electromagnetic spectrum shows energy distribution.

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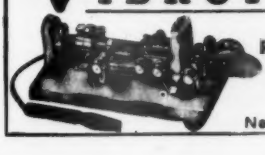

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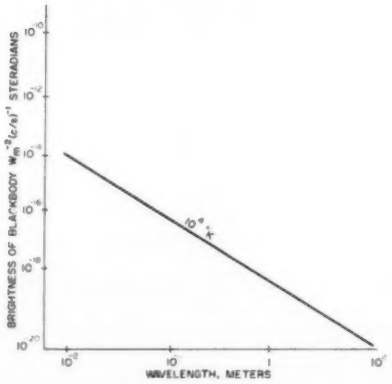


Fig. 2. Blackbody radiation, rf spectrum.

The large dish has been used for both active and passive radio astronomy (active radio astronomy being another name for radar astronomy).

As an active instrument it has allowed radar signals to be bounced off of the moon with great accuracy. Venus has also been a target for Arecibo's energy.

As a passive instrument it lays claim to being the world's largest telescope, optical or radio.

The $9 million project was built by Cornell University through funds made available by the Department of Defense's Advanced Research Projects Agency and the Air Force's Cambridge Research Labs.

Cornell University continued to operate the telescope after construction was completed.

Owens Valley Radio Observatory. The observatory which has located and identified more radio sources than any other observatory is the Owens Valley Radio Observatory of the California Institute of Technology at Big Pine, California.

Two 90 ft dish antennas make up the heart of the observatory. These are especially fine instruments built to close tolerances.

Financial support for the Caltech observatory was granted by the Office of Naval Research. The original construction cost amounted to $1,500,000. The telescopes were placed in operation in December 1958.

Australia. Much of the research in radio astronomy is presently going on in Australia.

B. Y. Mills is probably the most distinguished radio astronomer from the Island continent. He is the inventor of the "Mills Cross" which is an array of telescopes arranged for maximum gain. Mills is also responsible for most of the mapping of the sky in the southern hemisphere.

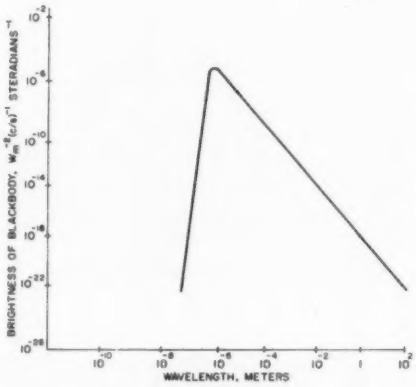


Fig. 3. Blackbody radiation curve for frequencies beyond rf portion of spectrum.

Radio Noise Sources

Radio waves make up a portion of what is known as the electromagnetic spectrum. The relative positions of the various forms of energy that make up the electromagnetic spectrum can be seen in Fig. 1.

The only difference between the various forms of energy is the wavelength and the energy they possess. In reality there is no sharp dividing line between the various forms but one form slowly takes on the identity of the next.

All objects above an absolute zero temperature radiate electromagnetic radiation into space with the energy being directly proportional to the frequency and inversely proportional to the wavelength. This is known as Planck's law and was formulated in 1901 by Albert Einstein.

A perfect radiator (and absorber) is called a blackbody source. A perfect black-

body is never found in nature, so the objects in space radiating electromagnetic energy fall somewhat short of the blackbody formula for brightness.

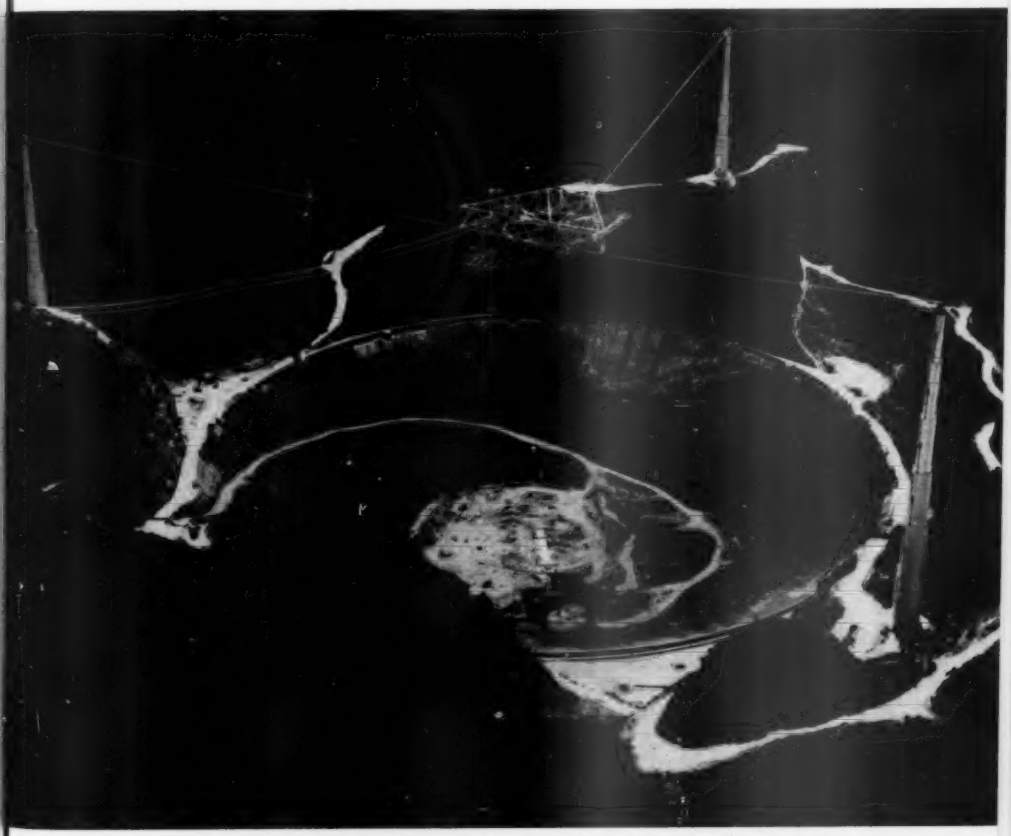
It should be obvious that brightness of a light wave is the same as signal level or intensity of a radio wave at a specific radio frequency.

When plotted on a logarithmic scale, the blackbody radiation looks something like the plots on Fig. 2. If the chart were extended past the radio frequency portion, the chart would look like that of Fig. 3.

Temperatures generated within the telescope itself often limit the ability to detect weak signals. The heat generated by transformers, vacuum tube filaments, sunlight heating the antenna, sunlight heating the transmission line, and heat from other electronic components must be taken into account.

The minimum temperature which the telescope will be able to detect can be found by a formula that involves such parameters as minimum detectable temperature, system noise temperature, rms system noise, antenna noise temperature, etc.

The above discussion has been concerned with what is known as thermal



The giant of all radio telescopes spans some 1000 ft in diameter and 500 ft from the feedhorn to the base. The feedhorn weighs 500 tons and measures 200 ft on each side. Arecibo has been used as both a radio telescope and a radar telescope. The 500-ton feedhorn is supported only by cables. Several contacts via EME with hams in the United States and around the world have been made on the ham bands with the big dish. (Cornell Univ., Arecibo Observatory, Puerto Rico.)

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blackbody radiation; however, other methods of electromagnetic wave generation are known:

Thermal emission from ionized gas: As an ionized gas the electrons are free from the nucleus and thus are in no specific energy level; however, the electrons are accelerated as they come in the vicinity of other charged particles. These accelerations of electrons cause electromagnetic radiations.

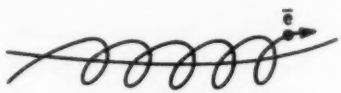

Fig. 4. Synchrotron emission: Free electrons in the arms of a galaxy moving at high speed in a gravity field.

Synchrotron radiation: The first emission which is nonthermal in nature is the synchrotron radiation (Fig. 4). In fact most nonthermal radiation in the universe is produced by this method.

Synchrotron radiation occurs whenever high velocity (high energy) electrons are accelerated to near the speed of light by a powerful magnetic field. The energy released by synchrotron mechanism is more intense than that released by thermal emission from ionized gas. As a consequence, this type of radiation is responsible for some of the most powerful sources yet detected.

Spectral lines: As electrons jump from lower to higher or from higher to lower energy levels within the atom, energy is either radiated or absorbed. This energy shows up as spectral lines throughout the electromagnetic spectrum.

Many of the spectral lines fall within the visual portion of the spectrum; however, some elements such as hydrogen are capable of producing spectral lines a considerable distance from visible light.

The most famous spectral line within the radio spectrum is the 1420.3 MHz hydrogen line. This is the spectral line produced by neutral hydrogen.

Evidence of this line is found throughout the universe; it occurs in open space between stars and between galaxies and at various temperature levels.

The above is only a brief survey of the mechanics of electromagnetic wave generation simplified from the book *Radio Astronomy* by John D. Kraus. Every serious student of the subject should consult Dr. Kraus' book for a more detailed discussion.

This portion of the text of this two-part article series has served to acquaint you with some of the individuals who pioneered radio astronomy as well as some of the technical disciplines involved in the field. Part II of the series will cover details about the radio spectrum of interest and describe basic radio telescope systems.

. . .W4ZBE■

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WHAT'S PAST IS PROLOGUE

Delivered by
A. Prose Walker
Chief, Amateur and Citizens Division
Federal Communications Commission

There are more VIPs here tonight than at a National Convention . . . W3RE.

Introduction by Nelson M. Griggs W3UCT
Photos by Paul Segal

Photo of Mr. Walker courtesy of Auto-Call.

Gaithersburg, Md., Mar. 11 – A. Prose Walker, W4BW, the new Chief, Amateur and Citizens Radio Division of the FCC, proposed tonight that a "professional" amateur satellite be launched in synchronous orbit, possibly at the direction of the President of the United States. Walker was the featured speaker at the 16th annual dinner of the Washington Chapter, QCWA, meeting at the Washingtonian Country Club. He further suggested that the new bird fly in 1976 in celebration of our nation's second centennial.

The glittering audience of 376 paying guests included, in addition to QCWA chapter and national officials, the Board of Directors, the Executive Committee, the Secretary and General Manager and other staff members of the ARRL.

Walker was introduced by Harry Dannals W2TUK, newly elected League president, following the presentation of Golden Anniversary awards to four local chapter QCWA members: Charles Lewis, W3AXW; Elizabeth Zandonini, W3CDQ; Charles Stay, W4HE; and Edward Clammer, W3UN. Dannals also took the opportunity to present ARRL life memberships to those eligible applicants (including Walker) who happened to be present.

Prior to the main event speculation had been rife as to what the new chief might say that had not been already widely publicized. In this, the fifth in a series of talks given before amateur groups around the country, Walker chose the questionable future as his subject.

The text of Mr. Walker's speech follows:

The selection of a subject for tonight was somewhat difficult. There were three categories which seemed to fit the occasion. First I thought of talking about "The Good Old Days," but there are many of you here who know much more than I about that era . . . who can better recall the virtues of spark, the pungent smell of ozone, the blinking of the "Slop Jar" rectifiers, MHz-wide amateur bands without much QRM. So I gave up on that one.

The next possibility seemed to be "The Troublesome Present." That is a subject that I probably know something about. But I have *been* talking about such matters recently, at Las Vegas, Dallas and Miami, and most of you know what I think about many subjects which concern amateurs today. Furthermore, your speaker on this occasion last year, Mr. Burch, talked about one of the most troublesome aspects of current problems, the interpretation of section 97.39 of the Rules, commonly known as the "eye bank docket." But neither that subject nor a lot of others are yet resolved. Probably it seems to you that it will take some kind of a miracle to conclude most of the pending matters. Well, I think that miracle has happened, for we now have John Johnston with us in our division, as chief of the rules and legal branch, responsible for the resolution of pending matters.

So rather than try to further elucidate any of those, I decided to discuss the only subject left, "The Questionable Future."

According to an old Chinese proverb, *"It is extremely difficult to prophesy, especially with respect to the future."*

But there are signs and events, if properly interpreted, which may give us the jump on the natural evolution of things in amateur radio, or perhaps even guide them to a more proper conclusion. At least it might provide the opportunity for a head start. Whether we take advantage of it is up to us.

In respect to the "questionable future" turn your minds, if you will, to the potential of satellite communication for amateur radio, as has already been demonstrated commercially. I know that you thrilled a couple of weeks ago to the sight and sound of our President and the events surrounding his trip to China. Last summer in Geneva, the ITU established the Amateur Satellite Service . . . A.S.S. . . . one of our well known pundits who is often in error but never in doubt, says that if we sit on it we are sure to lose it . . . which is generally the history of spectrum allocations . . . as it should be.

Recently, I had the opportunity of hearing some ideas on a *"professional"* amateur satellite from Bill Eitel, W6UH, well known to all of you as one of the founders of EIMAC, and a leader in the communications industry. We didn't have much time to work out the details, but Bill's idea stimulated some additional thinking about the kind of satellite he perhaps had in mind. During the next few minutes, let's think about that satellite . . . what it might be . . . what it could do . . . the limitations that probably will be imposed on it . . . and the best way to use it, not only for amateurs but for the benefit of mankind.

I say mankind, because we shall think about something that could be beyond the normal concept of the 'public interest, convenience and necessity."

All of the five OSCARs launched to date have been short-lived, low-altitude, non-synchronous orbiting satellites. Those that did contain repeaters /transponders or whatever you wish to call them, were available to only a small number of amateurs throughout the world . . . amateurs who had unusual competence to track the satellites and top-notch equipment for receiving and transmitting. The people who were instrumental in building and launching them deserve a tremendous

amount of credit for their pioneering achievements. Without their work, it is most unlikely that the ITU would have established the Amateur Satellite Service . . . it wasn't easy even with their achievements . . . and we didn't get everything we wanted, but at least we got our foot one inch further in the door. Let's speculate briefly about the major technical characteristics of one version of this "professional" amateur satellite (with apologies to Bill Eitel if this isn't quite what he had in mind).

One of the major objectives is that it be available over a long period of time: Not just a month or 6 weeks, but a period of several years.

Predicted life of satellites today is in the order of five years. Whether we could obtain that is debatable perhaps, but it should be operable for at least a couple of years. This requirement is synonymous with a solar cell power supply, backed up by batteries.

Secondly, for the satellite to be generally available, its orbit must be such that complicated orbit prediction is not required nor complex tracking equipment necessary. Third, and this is almost a part of Point 2, availability to all amateurs of the world at one time or another, points to a near-geostationary satellite; one which slowly drifts around the world remaining available for periods of weeks or even months to amateurs in any particular hemisphere. This is the kind of satellite I would like to discuss . . . not a toy, but a "professional" amateur communication satellite, the limitations of which are only those imposed by cost considerations and the decision to put it into orbit.

Perhaps you are skeptical at this point. Instead of thinking about it in terms of resources, turn your thoughts around 180°. For centuries it has been true that the availability of the resource produced the decision to accomplish the objective. Within the past decade that has changed, and now it is *the decision to accomplish the task which brings about the resource* necessary for the job. Throughout the relatively short period of our engagement in space exploration, the decision was first made to do the job . . . then we set about providing the resource which resulted in the technology and hardware to probe the outer limits of the earth's atmosphere and beyond. This list of man's accomplishments in space is long; Explorer, Vanguard, Topside Sounders, Earth Resources Satellites, Orbiting Astronomical Observatory, Solar Observatory, Geodetic Observatory, Weather Satellites, not overlooking the series of manned flights starting with Mercury, Gemini, Apollo, and now Skylab and Shuttle.

Without denying the "fall-out" benefits from this gigantic effort, none of these endeavors have really been for the direct benefit of the common man. This may well be the shining opportunity to bring the benefits of satellite technology down to at least a segment of the population of the world through a "professional" amateur satellite. If the decision to put this kind of satellite in orbit were made by the Director of the OTP or the President of the United States, how many of you doubt that it would go up? Why not have it ready for the Bicentennial celebration of our country in 1976? I hope and believe that this will come about, somehow, somewhere, in some way. I know that Bill Eitel is thinking seriously about the prospects. The technology is here . . . are the amateurs ready?

What kind of satellite is this? It must be reasonably small and lightweight, but this depends on economics. It must have enough rf power output and bandwidth to permit its simultaneous use by a number of amateurs. Without going "overboard" and just for discussion, let's assume that it has 20 watts output. The operating frequencies probably should be as high as possible without ruling out general participation by amateurs. Let's choose a satellite with an up-link frequency in the 435–438 MHz band and the down-link in the 144–145 MHz band. The choice of these frequencies is probably rather good because on 435–438 MHz, remember, the ITU has told us that we must have the capability of eliminating potential interference to other shared services in that band. Obviously, it is easier to prevent interference from the ground than on a satellite. On the ground we can realize substantial antenna gain at that frequency. This *could* be done on the satellite but there are other aspects to consider. As an aside, one of the currently planned satellite experiments in conjunction with ATS-G will be using a 30 ft dish in space, having a gain of 18 DBI (Syncart).

To the uninitiated, some of the terms used in space work are confusing. We don't speak of field strength in microvolts per meter, but of power flux density, DBW/M^2. The origin for this and other terms came from the field of micro-wave communication where they speak of signal levels in terms of quantities of energy (flux) per unit area. The term DBW/M^2 simply means a number of decibels above or below 1 watt of energy or power (flux) per unit area of 1 square meter, and is spoken of as power flux density. In order to relate pfd to something all hams are familiar with, keep in mind that 1μV/M of field strength is about equivalent to −147 DBW/M^2. So this gives us an understandable relationship between power flux density in DBW/M^2 and electric potential between two points in space, measured in μV/M. The rest of our discussion is mainly simple arithmetic concerning what we can do with our satellite.

Suppose that amateur "A" wants to have a QSO with amateur "B." The former has a 100 watt transmitter with an emission bandwidth of about 20 kHz, and a dish or a phased array having a gain of 15 dB. Therefore, his effective radiated power relative to an isotropic antenna (E.I.R.P.) is +35 dB or about 3 KW. At 435 MHz the attenuation of the signal (commonly called path loss) from amateur "A" to the satellite, a distance of about 22,000 miles, is 156 dB, a negative quantity. So the +35 dB of power has shrunk to a −121 DBW/M^2 by the time the signal gets to the satellite. If we assume the satellite receiving antenna gain is +15 dB, then the signal at the satellite receiver input will be about −106 DBW, about 40 dB above our reference, −147 DBW/M^2, or roughly 100 μVM (we'll leave off the M^2 for it is assumed). So now we have the signal into the satellite receiver.

Let's assume that the satellite receiver we have in mind has a bandwidth of 200 kHz (which will accommodate about 10 FM signals simultaneously) and has a noise figure in the order of 10 dB, which is about what a real good TV receiver has. Therefore the total receiver noise power in the 200 kHz bandwidth will be about −141 DBW, and amateur "A's" signal is about 35 dB above the noise at the input of the receiver.

If you want 10 or more simultaneous QSO's and we have only 20 watts output from the satellite transmitter, then any one signal should "appropriate" only 1/n times the available power output, n being the number of QSO's. Skipping a little arithmetic related to the satellite characteristics we find that Mr. A's signal of −106 DBW has now become Ø DBW or 1 watt, taking into account the overall gain of the satellite transmitter, transponder or repeater as you will. On the down-link frequency of 144 MHz, the signal path loss en route back to earth is nearly 147 dB. When we boost the 1 watt output by the satellite antenna gain of 10 dB, and then lose the 147 dB, we reach Mr. B's antenna at a signal level (remember we now call it power flux density, PFD) of −136 DBW. Add to this the receive antenna gain of say 10 dB, plus a receiver with a noise figure of less than 6 dB and the result is a signal-to-noise ratio of about 28 dB.

GREAT . . . only in practice it won't be quite that good because of inter-modulation among the 10 or 20 signals passing through the satellite, which will reduce the output sig-

nal-to-noise ratio to a value somewhat below that for one signal . . . say about 20 dB. This is the reason why the receiver noise figure should be as good as possible, in order not to appreciably add to the noise already present on the incoming signal. If we use FM, the output S/N will be equal to the input carrier-noise ratio plus the FM advantage. We now have a satellite about the equivalent in physical size to the original "Early Bird."

One of the greatest problems that amateurs will have to face and overcome (and this is *self-regulation*), is the necessary discipline to maximize use of the satellite. Our postulated satellite can handle about 20 QSO's simultaneously, depending on exact values of bandwidth and power output. But this capability will be realized only if all participants observe self discipline concerning their E.I.R.P. If some amateurs appropriate more than their fair share of the available power through the satellite, it will leave less for others trying to use the system. Another important aspect of discipline will be listening on the down-link frequency to make sure that the proposed channel is clear in both directions. If this discipline breaks down, the result will be not only *QRM in the ordinary sense*, but also *cross-modulation* among *signals of unequal power* in the satellite receiver and thus lower the S/N ratio for everyone using the satellite.

By now you probably have concluded that all is not as simple as picking up your telephone. Depending on economics, amateur satellites may be power-limited. Therefore we should maximime the watt-per-dollar product by choosing up-link and down-link frequencies so that we may obtain as much gain on the earth end of the circuit as possible. All the satellite does is take the up-link signal, boost it by the overall satellite gain, and retransmit it on the down-link frequency. Also these frequencies must be carefully chosen with due regard for electromagnetic compatability on board the satellite, which is a fancy way of saying that we must avoid things like the 3rd harmonic of the down-link transmitter jamming the up-link receiver. Without going into details, the choice of 10 simultaneous QSO's is probably a fairly good figure, even though you are probably thinking "that ain't much." But bandwidth is directly related to total noise power, and if we theorized on 100 QSO's instead of 10 everyone would have to raise his E.I.R.P. 10 dB or the quality of transmission would be reduced.

Probably this is as good a place as any to remark that we seem to always have with us the question of the best way to utilize bandwidth, whether we are concerned with phone and CW on the HF bands – or satellite communication. In the case of our satellite, if we consider the use of CW, it would be possible to hold simultaneously 200 QSO's on the basis of 1 kHz required bandwidth per signal. If you could accept a lower minimum bandwidth of say, 200 cycles per signal for CW (which is probably impracticable), we could accommodate 1000 QSO's . . . always keeping in mind the disciplines we mentioned earlier plus a few I haven't touched on. Probably the best and most acceptable solution, as in HF, is neither all phone or CW, but a reasonable mix of both. But in the satellite case, there has to be world-wide adherence to the disciplines built into the system, or the satellite will not function to greatest advantage.

Up to now we have covered the satellite itself, what it could do and the limitations that may be imposed. But to what purpose do we put it? If we are able to convince others that such a satellite is worth the investment, surely there must be some useful purpose. I would not suggest that we should never use it for some or all of the purposes that have been mentioned such as a *"Satellite DXCC"* a *"Satellite WAS,"* an *" All OSCAR BPL"* or perhaps even for just rag chewing. But I have a feeling that these things by themselves will not justify such a satellite. It seems to me that one of the greatest uses of such a satellite *can and probably should be for educational purposes* not only to train our own young people in the techniques of satellite communication, but also others around the world . . . using the satellite for the exchange of information, advice and actual experience in satellite communication. The so-called "new and developing" countries of the world have not yet reached an acceptance of amateur radio as a worthwhile utilization of the radio spectrum. Perhaps if they see a benefit such as this, it would impress them with the tremendous promise that amateur radio can have for them in the development of trained people in telecommunication. In the plenaries of the ITU, I can assure you, we need their support.

There is another purpose of such a satellite that should be thoroughly explored. Perhaps it is significant that *none* of the currently utilized or contemplated commercial satellite systems are specifically designed for use in the event of a natural disaster, epidemics, famines, floods, earthquakes, tidal waves and similar things which afflict mankind. The need for such a system of communication has already been recognized by the ITU. However, no existing space communication system makes provision for specific channels for emergency communication. Will the amateur satellite service be competent to meet the challenge in extending our charter of 97.1 (A)?

> *"Recognition and enhancement of the value of the amateur service to the public as a voluntary, non-commercial communication service, particularly with respect to providing emergency communications"*

Or are we "just little boys playing in our basements" as we have often been referred to in the assemblies of the ITU? If we *are* up to the challenge and have what it takes, we could create a lasting impression of competence and worthiness in the eyes of world leaders, not just in the plenaries of the ITU

Perhaps it is too large a bite to swallow in one piece, but if we don't seek a larger goal than we have before us at present, what is the future of amateur radio? Are we content to become fragmented among ourselves, arguing like spoiled children about who should occupy what portions of our HF bands, or even VHF, now that we have finally started to earnestly occupy them? Are we fundamentally just a bunch of hobbyists who would idly chatter incessantly over our transmitters which occupy precious spectrum space? How many of you have read recently the basis and purpose of amateur radio contained in Section. 97.1 of the Rules?

What is our responsibility to future generations who will inhabit "our bands" some day when you and I are "silent keys?" Are we leaving them a legacy for the future based on sound judgment and planning? The growth curve of amateur radio in the United States has been more or less static for a number of years. Not so in certain other countries! Novices have constituted about 8½% of our total; Technicians 19%; Conditionals 11½%; General Class 34% and Advanced and Extra Class 26%. Are we attracting a fair percentage of young people to amateur radio? Granted that competition is greater now than it was 50 years ago, but information and learning aids are also more available than they were when you learned the art of wireless communication.

We hear a lot about revolution today in our society. The only apparent impact on amateur radio that I can detect is the increase in illegal operation, the upsurge of foul language to be heard almost any night you turn on your receiver . . . (especially on 75 meter phone) and the apparent desire to lower the qualifications for an amateur license. This is not the kind of revolution we need in amateur radio. If we have the

imagination to confront and reshape it, we might expect that this revolutionary attitude could be of help to us rather than a hindrance, in planning for the future. But if it *is* to be a help, we must present a challenging view of what the young generation can accomplish, not just what they can get out of it in terms of enjoyment because that's not enough. Young people are keyed to a rapidly changing, complex society . . . almost impossible for an older generation to comprehend. Dr. Robert Hilliard explains it with the statement,

"At the rate at which knowledge is growing, by the time the child born today graduates from college, the amount of knowledge in the world will be four times as great. By the time that child is 50 years old, it will be 32 times as great, and 97% of everything known in the world will have been learned since the time he was born."

Today's youngster generally, is not thrilled by the same things that sent you and me into orbit 40 or 50 years ago. He takes for granted what still gives us goose-flesh in our hind-sight perspective of the development of telecommunication. The frontier of amateur radio is in the field of satellites. I fully appreciate the difficulties of trying to keep abreast of things here on earth. Nevertheless, I urge those who have the responsibility for plotting the future course of amateur radio to look far ahead, lest the immediate problems within and outside our ranks occupy too much of our energies to the long-term detriment of amateur radio.

Over the next few years, I hope the Commission can erect a few new road signs and perhaps replace some old ones, to assist in the development of amateur radio, and keep it going down the right road. Whatever we do, I know you will evaluate it judiciously in the context of our common goal.

In Shakespeare's play *"The Tempest,"* Antonio summed up what seems to me is our position today when he said,

". . . What's past is prologue; what to come, in yours and my discharge."

It is probably significant that the new FCC chief of ham radio was introduced by the newly elected president of the ARRL inasmuch as the powerful coterie of League wheels by no means came to Washington just to hear Walker speak. A highly placed league official, who declined to be quoted by name, told this reporter during the pre-dinner festivities that the group spent Thursday evening with OSCAR and AMSAT officials, and as a result drafted an agreement that would have lasting impact on ham radio in months and years to come. "Really tremendous," was all he would say, "without exaggeration." He refused to divulge any further details, but the impression was left that the ARRL, under the leadership of their new president, would take over OSCAR and AMSAT activities and merge them into the new "professional" satellite program.

Dannals, according to the dinner announcement, was also scheduled to speak, and many looked forward to a major League policy pronouncement. They were disappointed, however, when he confined his remarks to the distribution of some 7 or 8 life memberships and the introduction of Walker.

Another featured speaker was to have been the new president of the national QCWA, Barry Goldwater, W7UGA/K3UIG. He too was anticipated with eagerness, not only because of his U.S. Senate position (R. Ariz.), but also because of his considerable influence in amateur affairs. But Barry bowed out by telegram at the last minute.

Thus Walker had the stage almost to himself, except of course for the venerable Robbie, perennial toastmaster for these affairs. Mr. Harold H. Robinson, W3RE, is a perceptive and progressive thinker, and, despite his advancing years, is younger in mind and in heart than most of his younger contemporaries. Robbie and Mac Williams, K3AC, are wholly responsible for the success of these affairs over the past years.

The League has its dissident members here in the Washington area, however. One such, a ham of long standing and a loyal life member of the League, deplored the often untrue statements in the pages of QST concerning League activities. Also declining to be named, this Washington ham cited the minutes of the Directors' meeting and the editorial (p. 9, March) in QST concerning the outgoing president. "' . . . announced he would not be a candidate' indeed!" this ham said. "It is common knowledge that WØDX expected reelection as a matter of course, and was very upset when he was told two days before the election that he didn't have a chance. When Dannals was elected unanimously . . . " and here words failed him. When asked how he felt about the future under the new leadership, he replied, "U.S. amateur membership in the ARRL, its alleged representative society, is now only about 30% while in other countries ham membership in counterpart societies is between 80 and 90%. The outgoing president was a figurehead, a lousy director. This new man is a doer, full of pep, and capable. I think we are now in good shape. That's why I bought a life membership."

Robbie, W3RE.

200 years of hamming. Gus Gironda, W3JE, president of the Quarter Century Wireless Association, awards 50-year certificates to Charles Stay, W4HE, Edward Clammer, W3UN, Elizabeth Zandonini, W3CDQ, and Charles Lewis, W3AXW. All four recipients of the award have been active continuously throughout the half-century.

One highlight of the evening occurred when, just as Walker was getting warmed up, a shirt-sleeved attendant approached the lectern with a note and asked Walker to announce it to the audience. Walker took the note and read, "Cadillac sedan – several years old – 151713 – what about it?" The attendant announced, for all to hear, "The motor's running." Walker said, "Honey, that's your car." and Mrs. Walker left the room to remedy the situation.

Earlier, Walker had told the following story: "The other day I was discussing ham radio with a good Catholic priest neighbor of mine, name of Father O'Malley, and in the discussion I mentioned the name of Bob Booth (W3PS, ARRL General Counsel), and he wanted to know who Bob Booth was, and I said, 'Why, do you know him?' and he said, 'No, but his name comes up frequently while I hear confesssions.' " When asked later what Walker had meant, Booth, redfaced, replied, "I don't know, but I'm damned sure it wasn't complimentary."

All in the spirit of good, clean fun.

... W3UCT

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The basics of how noise in various forms limits the performance of receiving antennas and systems is explored. The subject of ultra-miniature antennas is also covered.

NOISE AND RECEIVING ANTENNAS

One of the topics that the newcomer (and some oldtimers) find confusing is the relationship of noise in its various forms to the performance of receiving systems. Or, thought of in a different way, the subject of how sensitive a receiving system should be and what the ultimate degree of usable sensitivity is for a receiving system. This article discusses these topics in a general and nonmathematical manner. The mathematics of receiving systems with terms such as signal-to-noise ratios, noise factors, dBm sensitivity levels, etc. is not extremely complicated once one has developed the necessary conceptual background. However, for many amateur purposes, the mathematics of receiving systems need not be indulged in simply to experiment with the improvement of a receiving system. The main requirement to perform meaningful experimentation that is directed in a useful direction is simply to understand the interrelationship of the various elements in a receiving system and how changes in the characteristics of one element affects the overall receiving system.

Basic Reception Criteria

For the purpose of understanding a transmitted signal, the signal as it appears at the output of a receiver must be a certain level above the background noise. This criterion is true for CW and voice reception where an operator is the final "processing" device in the receiving system. Such a criterion may not be true for the transmission of signals which are completely electronically processed. The amount by which the intelligence signal must be above the background noise for an operator to be able to understand the intelligence depends upon several factors. For a highly experienced CW operator, a CW signal may only have to be a few decibels above the noise level to allow solid copy. For "voice," some words may be heard when the signal is only a few decibels above the noise level, but complete understanding may require the signal to be 10–20 dB above the noise level.

These considerations are further complicated by the fact that if the receiving operator has some foreknowledge of what is being transmitted, he will automatically start to fill in missing portions of a transmission.

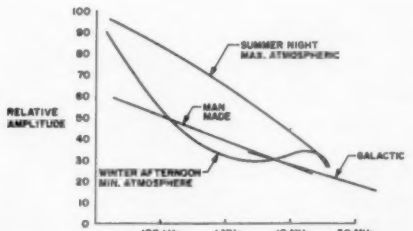

Fig. 1. The main sources of noise that influence reception. The exact amplitudes depend upon location. The relative amplitudes shown are those typical of the Middle Atlantic Coast.

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This sort of situation occurs quite often – for instance, when a contact has been established and the usual "RST, QTH, and name" information is sent. Many QSOs fall apart after such information is sent because the receiving operator no longer knows what to expect (this assumes that the code speed proficiency of the receiving operator is always adequate.) So, there is a basic human characteristic involved in any type of CW or voice reception and the only overall definitive statement that can be made is that the human operator for aural reception requires the received signal to be some level above the noise level to extract intelligence from it.

Noise in a Receiving System

Starting back at the transmitter, and assuming the noise output of the transmitter is insignificant, the signal radiated in the immediate area of the transmitter is many times stronger than the electrical noise level. As the signal is propagated, its intensity decreases. At the reception point, the signal level will have some level as compared to the noise level at the receiving site. The noise level at the receiving site can be a combination of many things – atmospheric, man-made, and cosmic noise. Some of these noises are shown in Fig. 1. along with their variation with frequency. As can be seen, atmospheric noise can vary with time of year as well as with frequency. It also varies considerably with location. The type of noise which predominates depends upon a particular location. Man-made noise is a particularly unknown factor in any location. The other noise sources lend themselves to prediction and calculation, and many charts, maps, etc. can be obtained relating to them. The very simple but still important consideration at this point, however, is that a desired signal (Fig. 2) arrives at a reception point with a definite level as compared to the noise at that point. Aside from the possibility of eliminating man-made noise, there is nothing that the receiving operator can do about this ratio of signal-to-noise level.

The next step in the receiving process (or perhaps the first step, depending upon how the process is defined) is the coupling provided by an antenna. The idea of an antenna as a coupling device is convenient for remembering that it couples both the signal and external noise to the rest of the receiving system. Unfortunately, this coup-

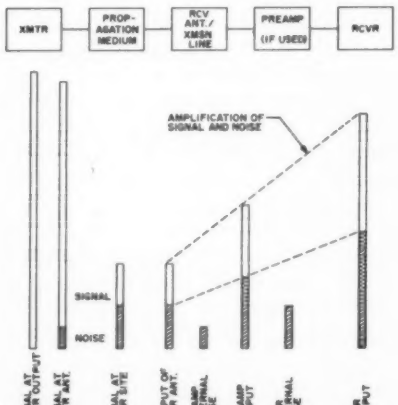

Fig. 2. The effect of noise and amplification at various steps in the transmitter output to receiver output chain.

ling process requires some kind of current flow and any kind of current flow is going to produce more noise. The noise produced is directly related to the losses in the system. These losses (attenuation) reduce the amplitude of the coupled signal and noise, but also introduce new noise. The fact that the amplitude of the signal and noise take on a new ratio is what makes the receiving system suffer – not the simple attenuation of the desired signal alone. For the moment, let us assume that the signal-to-noise amplitude ratio does not suffer during the antenna coupling process.

The next noise source encountered is that provided by a preamplifier, if such a device is used. As shown in Fig. 2, this noise source is shown to have a level less than that of the noise portion of the signal and other noise coupled into it. The amplifying device amplifies both the signal and the noise coupled into it. The output, then, is an amplified signal, amplified noise, and noise generated by the amplifying device. If the amplifying device is good, the signal-to-noise level ratio at its output will almost be the same as that at its input. But it can never be better.

If a signal-and-noise input is coupled directly to a receiver where the noise input is less than that of the receiver noise, the latter will "mask" part of the signal and a poorer signal-to-noise level ratio will occur at the receiver output than was coupled into it.

On the other hand, if the receiver-generated noise level is so low that it is always exceeded by the noise portion of the signal and noise input to it, a preamplifer has no value. The use of a preamplifer in such a case will make things sound louder, but it cannot improve the signal-to-noise level at the output of the receiver over what that ratio would have been if the input signal has been directly processed by the receiver. In fact, if a poor preamplifer is used which has an internal noise level greater than that of the receiver itself, the use of such a preamplifier will actually degrade receiver performance.

It should be noted that in all the signal transfer, processing, etc. which takes place, the objective is to *preserve* as much as possible of the original signal-to-noise level of the input until it can be amplified to the point where it is capable of being used to drive an audio transducer. If one remembers this simple idea, it will be obvious why losses have to be avoided as soon as possible in the receiving process, why preamplifiers should be placed as early as possible in the receiving process, and why a preamplifier, to be useful, has to be a very low-noise device.

The Receiving Antenna

From the foregoing, it would seem that the minimum requirement for a receiving antenna is that it just be large enough to pick up enough external noise to exceed the noise generated internally in the receiving system. Any signal could be received,then, since any signal to be useful anyway must have a level which exceeds the external noise level. This idea is basically correct. What, then, is the value of beams and other very directive antennas for *receiving* purposes?

A beam may have a transmitting gain of several decibels or more but it is still a passive device and, as such, cannot amplify any signal. It cannot produce a gain for receiving purposes in the sense that it amplifies a received signal. What a beam or other directive antenna can do is illustrated in Fig. 3. The omnidirectional antenna picks up both noise and signals from all directions. The directive antenna picks up signals from one direction but, more importantly, also only noise from one direction. The signal-to-noise ratio at the antenna terminals is enhanced in the sense that the total noise pickup of the antennas has been reduced.

It should be noted that the terms "gain" and "directivity" are related but have dif-

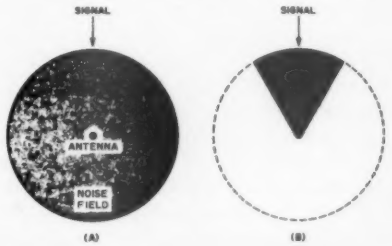

Fig. 3. The value of antenna directivity (B) for receiving purposes over an omnidirectional response (A) is that noise coming from directions other than that where a desired signal originates is discriminated against.

ferent definitions. Both can be expressed in terms of decibels and for some antennas, their value is the same. A large beam has gain for transmitting purposes and also exhibits usually an equal amount of directivity for receiving purposes. A very small antenna can still have directivity (a loop, for instance) but absolutely no gain.

If a very small antenna can exhibit the same directivity for receiving purposes as a large antenna, the question naturally arises as to why a small antenna should not be used instead for receiving purposes. Then, if one could only erect a modest type of transmitting antenna, it still would be possible to have a very effective receiving antenna. The situation becomes even more intriguing when one considers that, theoretically at least, a very small physical antenna provides the same amount of signal pickup as a large antenna. The amount of signal pickup of an antenna itself is not a direct function of its physical size. The advantage of a full-size antenna is that its terminal impedance is such that it matches to a transmission line or some sort of simple coupling circuit and, therefore, an efficient transfer of power from the antenna can take place.

The recent work which has been done on miniature or ultraminiature antennas has been directed toward finding an efficient method to transfer power from the physically small antenna. Transistor stages have been used as a coupling device instead of tuned circuits to match the highly reactive terminal impedance of an antenna very short in terms of wavelengths. Another approach has simply been to use an antenna length just long enough which would theoretically pick up enough atmospheric noise to be greater than the internal noise level in a receiving system. Such an antenna need only be a few inches long, for instance, at almost any frequency above the medium-wave band. The antenna is fed into a preamplifier stage with an extremely high input impedance so that the antenna is not "loaded down." Whatever approach is used, however, the factor of noise still enters into the picture because of the transistor stage used as part of the antenna (whether the stage is called a matching stage or a preamplifier). Active antennas do work, but the question of whether it is worthwhile to very carefully construct the active antenna using very low noise components, or simply to try to make a conventional antenna form electrically larger (perhaps by loading techniques) is a moot one. After all, there are very few situations where one cannot put up some sort of antenna that is more than a few inches long.

Noise Tests

Even with just *some* understanding of the role that noise plays in a receiving system, one can make some subjective analysis of what effect various components have upon a system. For instance, if the terminals of a receiver are resistor-load terminated, the antenna peaking control should produce a distinct increase in noise level at some point. With a terminated transmission line added to the receiver, the same peaking action should occur and the noise level output should be the same or slightly greater than before. If a preamplifier is used and its input terminated, the noise level should not increase if the receiver gain is adjusted to compensate for the gain of the preamplifier.

The best way, of course, to check the effectiveness of a preamplifier, or any similar device added ahead of a receiver which is supposed to improve its performance, is an actual reception test. If the preamplifer is switched in and out and a very weak signal can be heard with the preamplifer that could not be heard without it, you can be sure that the preamplifier has value. Note, however, that if a signal that can be received without the preamplifier simply sounds louder with the preamplifier being used, this does not signify anything about the preamplifier except that it produces some gain. Antennas can be checked against each other by being careful to keep the gains in a receiving system constant and noting which antenna, or what modifications to one antenna produce the best signal-to-noise level at the output of a receiver regardless of how "loud" a signal may sound. If the signal-to-noise ratio is the best possible, "loudness" can be provided at any point in the receiving system by means of additional gain.

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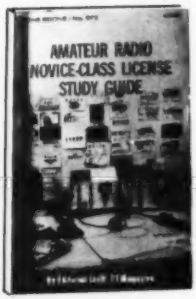

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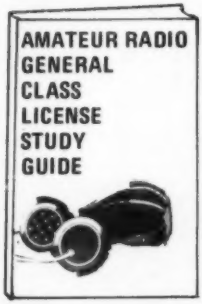

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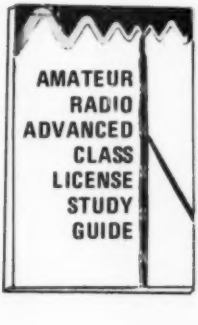

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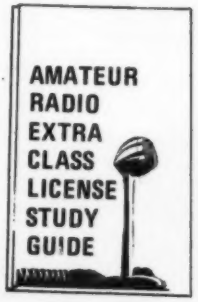

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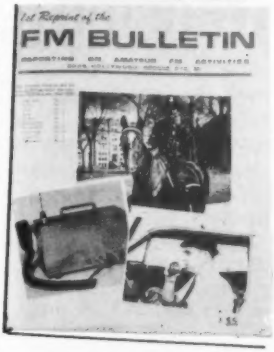

F The FM Anthology has reprints of all the articles and technical data from the early issues of the FM Journal. No FM library is complete without this data, much of it just not available elsewhere. $5.95 value.

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P. J. Ferrell W7PUG
6021 S. 199th Street
Seattle WA 98178

The Sewerpipe Antenna

The perhaps unfortunate name for this otherwise superb antenna derives from the fact that the chromium-plated brass tubing used as a matching section (normally obtained along with some funny looks from your friendly local plumbing supply house) was originally manufactured for quite another purpose.

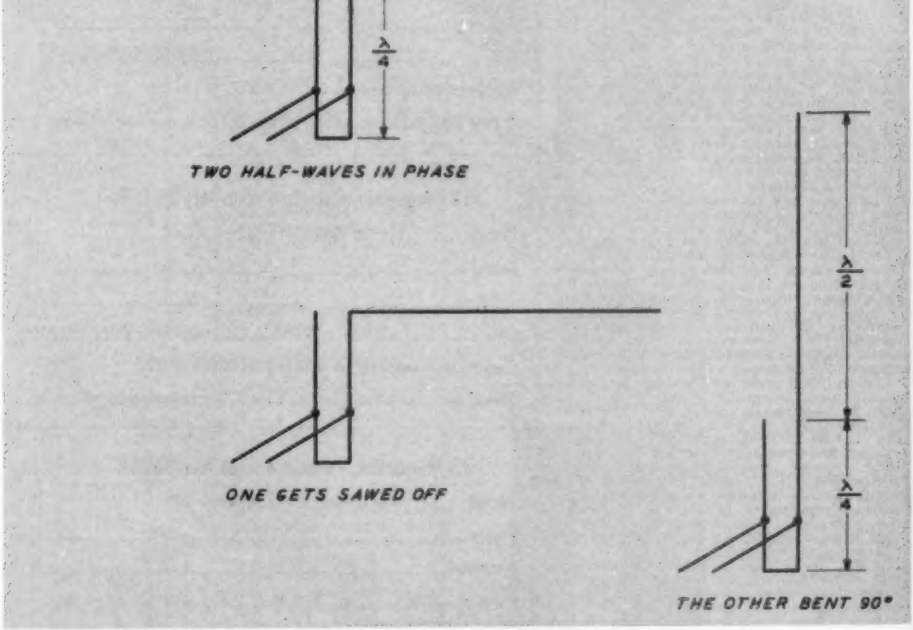


Fig. 1. Evolution of the J antenna.

It all starts with the J antenna, the evaluation of which is illustrated in Fig. 1. The J consists of a balanced quarter-wave matching stub feeding an unbalanced load as shown in Fig. 1 (C). But since balanced stubs work best with balanced loads as in Fig. 1 (A), some means of compensation must be provided to make the J workable.

Because of the unbalanced load on the matching section of a J antenna, the currents in the matching section are no longer equal and opposite, so the matching section radiates also. The resulting imbalance also couples rf currents to the supporting structure and the feedline, distorting the radiation pattern and making the antenna diffiuclt to match.

The step from the J to the *sewerpipe* arrangement is simple. Use an unbalanced coaxial matching section for the unbalanced half-wave load. Adjusting the antenna's impedance to 50Ω is easily accomplished as shown in Fig. 2.

Chrome-plated brass pipe of 1½ in. diameter is recommended for the matching section. If ordinary brass tubing is used, then a brass plug for the bottom can be turned to fit the tubing. Mechanical details are dependent upon the materials available, and will be left to the ingenuity of the builder. Dimensions are not critical, but things should fit together tightly. The inside depth of the matching section should be about 19 inches. Keep the plastic cap (Fig. 2 (A)) thin and use low-loss dielectric material, as this is a high voltage point. The internal feed assembly is physically similar to the gamma match used for unbalanced feed of a yagi antenna (omitting the series capacitor, of course). A clamp (Fig. 2 (B)) comples the connection from the off-center coax to the center conductor. The height of this clamp and the center-to-center spacing of the off-center member is varied to obtain a perfect match to 50Ω.

An interesting variation on the original sewerpipe antenna was developed by Prof. D. K. Reynolds (K7DBA) of the University of Washington. A different feed technique is employed, as illustrated in Fig. 3; the result is an ideal antenna for base station use. Antennas of this type are in use at Byrd

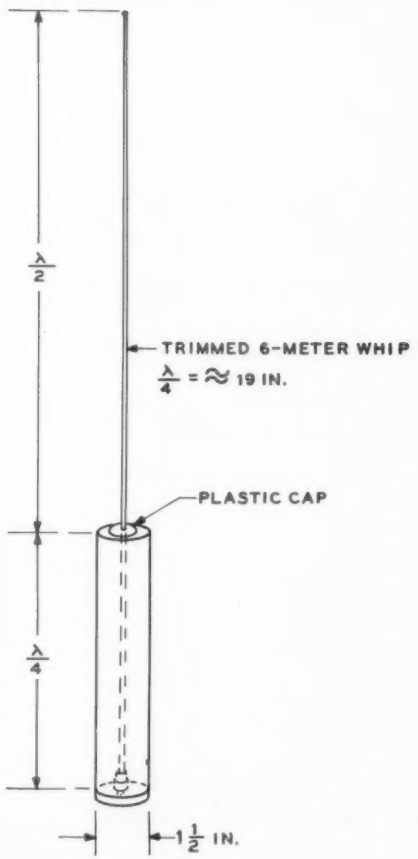
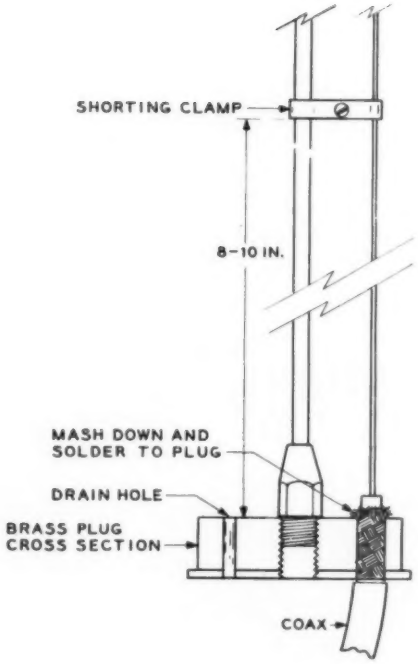


Fig. 2. The sewerpipe antenna.

VLF Substation, Longwire, Antarctica, home of the 21-mile dipole. There they use 146.76 MHz VHF/FM for both on-site and station-to-station communications.

Semigrid coax is used, and the 60Ω section is made by removing alternate half-inch sections of the dielectric inside the coax for about 16 inches. This raises the characteristic impedance from 50 to about 60Ω. The original version is more suitable for mobile use, however, because of its greater rigidity and mechanical strength.

Patterns taken at the University's antenna range show an almost perfect free-space dipole pattern. The measured gain over an isotropic antenna was 1.62 dB as compared



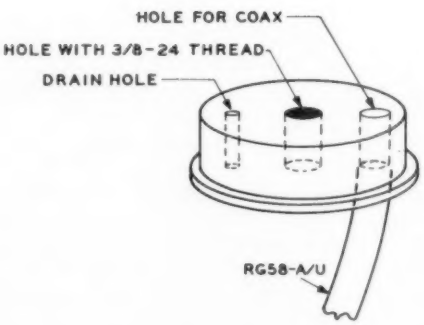


Fig. 3. Plug details.

with the theoretical value of 1.64 dB for an ideal dipole antenna. These antennas are unbelievably well decoupled from their supporting structure and are therefore a breeze to match. The only significant current is on the antenna itself.

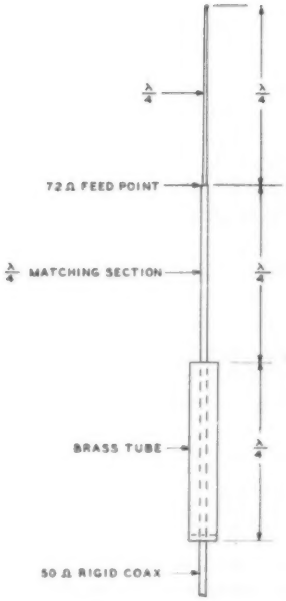


Fig. 4. Reynolds modified sewerpipe antenna.

Since no claim is made for extra gain, then where is the claimed improvement over other antennas? Basically, it is in the reduced angle of radiation. Practically speaking, most mobile antennas at two meters – whether ¼ or 5/8 wavelength – have about the same gain toward the horizon; moreover, they all suffer to some extent *finite groundplane* effects, which act to lift the angle of maximum radiation intensity above the horizion. Thus the secret of the sewerpipe antenna's performance is its straight-out angle of radiation.

If you live in an area well covered by an accessible repeater and don't stray much, the quarter-wave whip may be just right for you. But if you need long-range capability for your mobile, give the sewerpipe a try. They have been widely used in the Pacific Northwest since 1961. The sewerpipe is ignored by all CB'ers (unlike a 5/8-wave whip), but seems to disturb the 75-meter mobile operators for some reason. Could be they think it's a new chrome-plated loading coil.

. . .W7PUG

Eric Falkof K1NUN/1
Assistant Editor
73 Magazine

PICKERING KEYBOARD KEYER

I had the Pickering Keyboard Keyer on my operating desk when an RTTY friend came in. "Don't you have to push FIGS to get numbers and punctuation and then LTRS to unshift?" he asked, forgetting that I didn't even own a printing unit. "No," I said, "this is for CW." "Then how do you send the dits and dahs?"

The Pickering Keyer is a fascinating unit that eliminates the mental gymnastics of translating letters into Morse code sounds. Lightly touching any of the glare-free buttons, even for an instant, will produce the Morse representation of the character. All letters, numbers, punctuation, and ham procedure signs ($\overline{AR}$, $\overline{BT}$, $\overline{SK}$ . . .) are self-completing once they have begun. For example, to send CQ, just touch C and then Q. Unfortunately, there is no memory for letters as there is for a dit or dah in conventional keyers. While the C is playing, the Q should be held down. This Keyer will complete the C, insert the correct between-letters space, and then it will send the Q. Longer words can be sent by touching the first letter and while it is being sent, hold the second. Once the second has begun, move your finger to the third and hold until it begins, and so on. Letter spacing is automatic; word spacing is up to the sender.

Obviously it is necessary to be familiar with a typewriter keyboard and a knowledge of touch typing is an asset. Knowledge of CW is still necessary to know when to move fingers from letter to letter. Since some letters are shorter than others, at higher speeds you have to be quick. The speed is adjustable by a front panel control from about twelve to seventy words per minute. Slower speeds are possible by increasing letter and word spacing. The dit length can be varied by the weight control. Some keyers are pre-adjusted for weight, but being able to adjust it is an advantage because copying ability can change with dit length, depending upon the rate at which CW is being sent. The letters will be sent in perfect form.

How easy is it to use? Very. First, plug the unit in and hook up a loudspeaker or headphones to the appropriate jacks on the rear panel. Turn the KB-1 on and press a few buttons to get the feel. Very little pressure is required to activate the IC logic systems to send letters. The keys have a barely perceptible movement and this makes rapid finger placement possible. The monitor produces a low pitch tone that is easy to hear above background noises without blotting them out. The volume level is an adjustment on the front panel. After practicing for several hours it becomes second nature to push a

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button and to hear the correct letter emerge from the monitor. Finger placement, even for a hunt-and-peck typist, becomes easy and rhythmic. Adjustment of the keyer speed to a comfortable rate coupled with a relaxed typing speed still allows the hunt-and-pecker to send perfect CW at speeds up to twenty words per minute. The Pickering is heavily weighted and it will not slide across the operating desk. You could even use it sitting upon your lap if you wished to use CW while mobile.

After becoming accustomed to hearing a complete letter in Morse when moving one finger a fraction of an inch, I tried the unit on the air. I told my contacts what kind of keyer I was using and comments included, "That's cheating" . . . "Sounds clean" . . . "Pretty good." Sending became effortless. The hand rhythm developed quickly and smoothly and the letters flowed out as I thought of them. It was a BPLer's dream.

The unit is ideal for code practice sessions, as we use it here at 73. It is easy to pick the unit up and carry it to classes, and even a beginner can send perfect code without even knowing it. This new dimension to learning also allows the sender to learn characters and spacing. The speed can be adjusted to a moderately high rate and long spaces can be inserted to give the impression of slower speed. This, incidentally, is the newly approved method of teaching CW: fast letters with long space. It allows the listener to adjust to the concept of shorter letter timing, just like he will get in actual copy off the air.

To hook it up to your rig requires looking at the transmitter's schematic. You must determine the voltage across the key, positive or negative, in order to connect the cable to the correct keyed output. This protection is necessary to protect the integrated circuits that make up the circuitry. If you make a mistake, no damage occurs.

For the ham who takes Morse code seriously or for the professional code practice instructor, the Pickering KB-1 Keyboard Keyer is an indispensable tool for perfect CW. True perfection costs only $265 from the *Pickering Radio Company, P.O. Box 29, Portsmouth RI 02871.*

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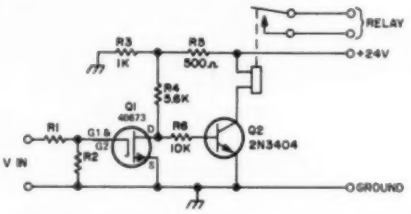
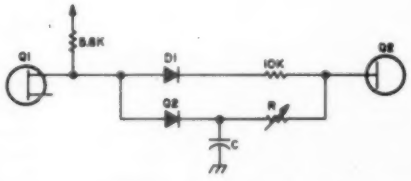


The first transistor stage utilizes a MOSFET with an extremely high input impedance. This feature allows connection to nearly any receiver with a minimum of loading. A negative going voltage of more than −3V is required to activate the COR. This voltage can normally be obtained from within the receiver squelch circuitry. With no received signal V_{in} should be approximately 0V.

R_1 and R_2 are chosen so that the gate to source voltage (V_{gs}) is at least −3V with a received signal. But not more than −6V. For V_{in} in the range −3 to −6V R_2 may be eliminated. Typical values are in the range 1−10 MΩ. Q_1 is conducting sufficiently during no-signal conditions to prevent sufficient base current from turning Q_2 on. When a signal is received Q_1 is cut off driving the drain potential up and the base of Q_2 receives adequate current to saturate, causing the relay to be activated. Q_2 is a standard NPN bipolar transistor with a high h_{FE} (dc beta). R_3 and R_5 are used to limit V_{DS} to +15V.

For 12V operation, R_3 and R_5 are eliminated, R_6 is reduced to 5.6K and a 12V relay is used.

With the addition of only 4 components the COR can be given a variable release (hold timer) function. Shown schematically below the relay can be set to provide up to 30 seconds or more of hold time after the carrier has disappeared.



D_1 and D_2 are 50 PIV 100AM diodes. The hold time is determined by the RC product. Typically, the C of 200 μF and R of 5K the hold time was 10 seconds. Values will differ from transistor to transistor and should be determined experimentally.

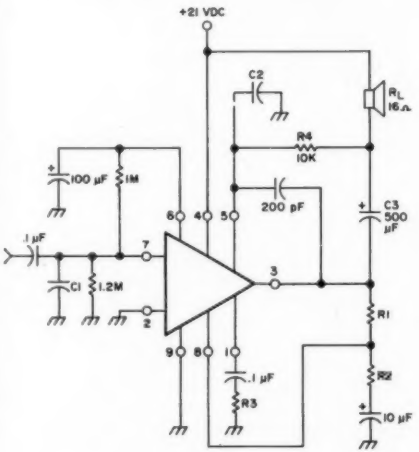
This solid state COR should provide you with a low power (.4W max) yet flexible device for your repeater or other carrier signaling functions.

. . . .KØMOC

CIRCUITS, CIRCUITS, CIRCUITS...

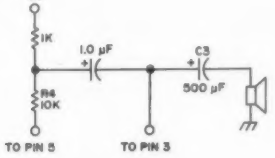
The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.

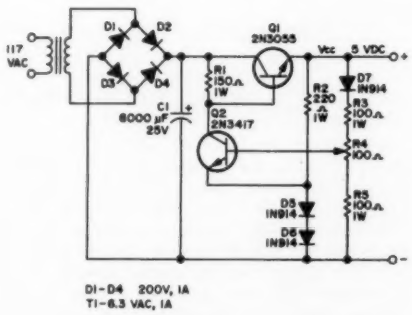


SENSITIVITY FOR P_o mV	C1 pF	C2 pF	R1 K OHMS	R2 OHMS	R3 OHMS	R_L OHMS	P_o W
560	0	0	10	1.0K	82	8.0	4.0
15	100	100	51	100	2.2K	8.0	4.0
630	0	0	10	1.0K	82	16	2.5
17	100	100	51	100	2.2K	16	2.5

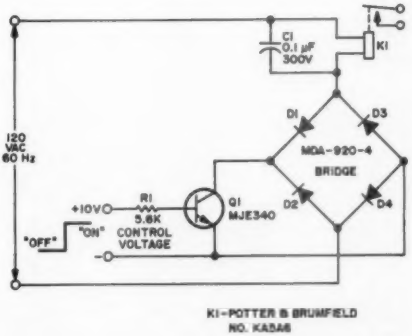
Alternate connection to permit connecting speaker to ground instead of to V^+:



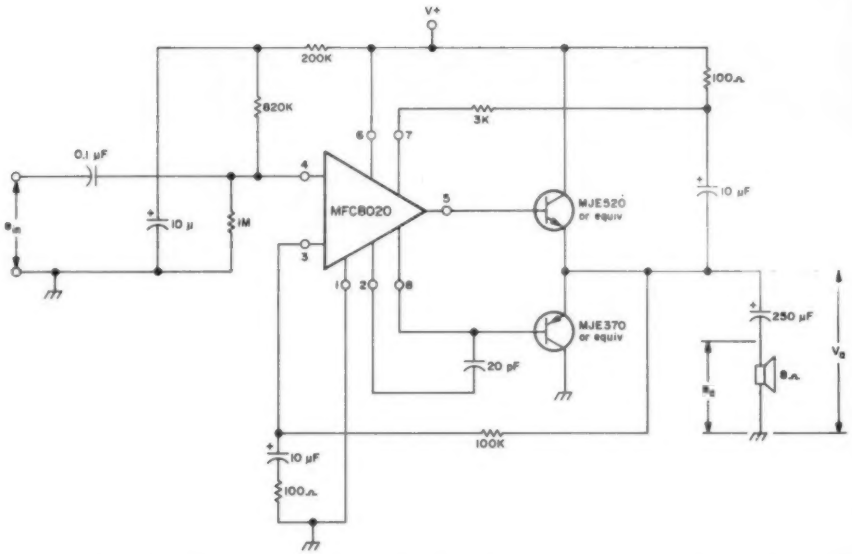
Motorola Functional Circuit MFC9000, in a typical application. This solid-state device is a 4-watt audio amplifier designed to provide the complete audio system in TV, radio and hi-fi equipment. Circuit courtesy Motorola MFC Handbook.



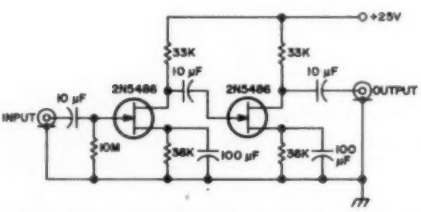
Regulated 5V power supply for ICs, by VE7BWF, reprinted from "Zero Beat," published by the Victoria Short Wave Club, Victoria, British Columbia.



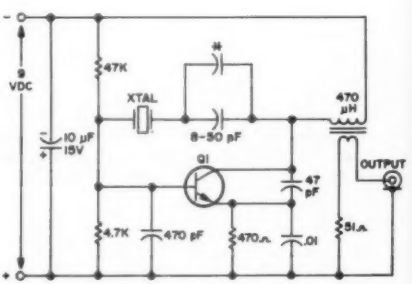
Electronic control of an ac relay with less than 2 mA current required to operate. Circuit courtesy Motorola Semiconductor Power Circuits Handbook.



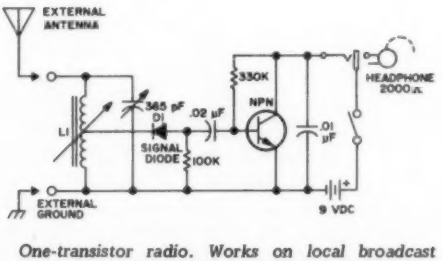
Typical application and test circuit (10-watt amplifier) using a Motorola MCF8020 class B audio driver silicon monolithic functional circuit. The MFC is designed as a preamplifier and driver circuit for complementary output transistors and will drive up to 15 watts output (4 ohm load). Application circuit courtesy of Motorola Functional Circuits Handbook.



Low frequency preamp 1 Hz to 50 kHz, voltage gain 400, extremely low noise, all capacitances in μF, all resistors ½W, transistors 2N5486. Circuit thanks to WA3EEC.

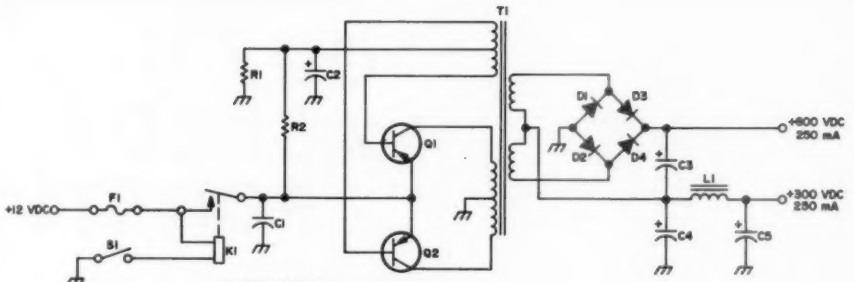


Q1 – VHF PNP (GE-9, ES15, etc)
* – MAY BE NEEDED IF TRIMMER WILL NOT ZERO-BEAT. ADD IN 50 pF STEPS.



One-transistor radio. Works on local broadcast stations. Amuse the Jr. op. Circuit courtesy Calectro Handbook. L1 is a ferrite variable antenna coil (Calectro D1-841). D1 is and signal diode (Calectro K4-550).

Two meter crystal oscillator. The transmitter crystal is used, the netting capacitor is adjusted so that the crystal is zero-beat with someone who is considered as being on frequency. Then the oscillator may be used to align a receiver. Since the output is so high (measured 18 volts peak to peak across the choke), it must be loose coupled to the receiver. This is done by winding two turns around the choke. One end of the winding is connected to the connector; the other end is connected to a 51 ohm resistor, which is then connected to ground. This circuit is very active and will handle crystals from 2 MHz to 30 MHz. (Thanks to VE7AZH.)



C1-250 pF, 100V
C2-10 μF, 25V
C3, C4-40 μF, 450V
C5-100 μF, 450V
D1, D2, D3, D4-HEP 160
F1-3A
K1-12V DC AUTOMOTIVE HORN RELAY.
L1-10H, 250 mA
Q1, Q2-HEP 233 TRANSISTORS MOUNTED ON HEAT SINKS.
T1-TRIAD TY84

Mobile transceiver power supply (from The Keyer *Ventura County ARC). 12V in, 600V @ 250 mA and 300V @ 250 mA out. Mount transistors on heatsinks.*

INDEPENDENT RECEIVER TUNING FOR TRANSCEIVER

Did you ever wish you could tune the receiver section of your transceiver without changing the transmitter frequency? Sure would be nice on CW for setting the tone of the station you are working, or for SSB roundtables where everyone never seems to be on the same frequency. It is extremely simple to do if you have an extra set of contacts on your TR relay in the transceiver, or room for another relay. Stability is not affected; however, the vfo must be recalibrated. Such a device has been in use here for about three years, and I would be lost without it.

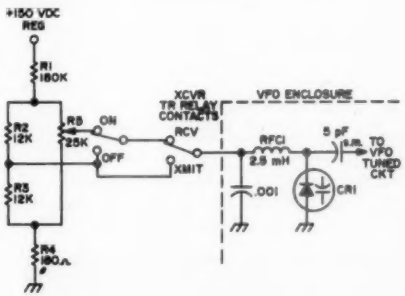
Referring to the drawing, CR1 is a Varicap Diode Motorola MV1642 or Hughes 1M954. It changes capacity as the voltage to it is varied (working like a variable capacitor). When transmitting, the diode is given a steady voltage from the voltage divider R1, R2, R3, R4. When in receive, the potentiometer R5 is supplying the voltage to the varicap. With R5 in the center of its range, the control voltage is about the same as in transmit, so there will be no offset. Moving R5 above or below center will tune the receiver plus or minus from the transmitter frequency. Switch S1 bypasses the offset control and allows normal transceiver operation.

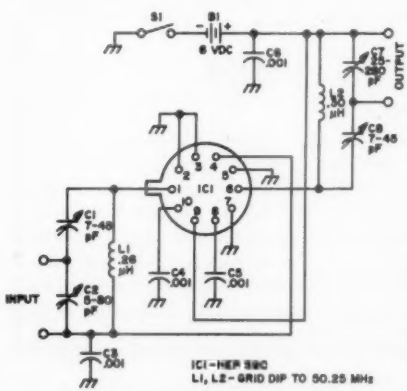
C1, C2, RFC1, and CR1 should be mounted inside the vfo enclosure. The other components can be anywhere, including a separate box outside the transceiver. Recalibrate the vfo with the switch in the off position. As shown, the offset is about 2 kHz. If you want more offset control change C2 to 10 pF.

I hope receiver offset will increase your operating enjoyment as much as it has mine. Cost is $6 or $7 if all parts are new.

. . .W2FBF

Circuit courtesy WCRA SCOPE.





Six meter pre-amp with 30 dB of signal gain and 600 kHz bandwidth. The input and output impedances are matched. AGC may be added to pin 5. For FM use dip the coils to 52.5 MHz. Circuit from Motorola HMA-36, Radio Amateur's IC Projects, available free from Motorola, Dept. 73, Box 20924, Phoenix AZ 85034.

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SIGNAL REPORTING -A RECAP

Like all of man's methods of measurements, our RST (readability, signal strength, and tone) system for giving signal reports have come down to us through a long and painful evolution. The fact that it has been used, unchanged, for more than a quarter century, indicates that the end product has been pretty successful.

There were lengthy times of mild confusion when, in transitional periods, more than one code was in general use before blending into another. It also took a long time for the idea to emerge that readability and signal strength had to be treated as separate entities.

Any ham with enough whiskers to join the Old, Old Timers Club (I.E., licensed 40 years ago), will recall the original R scale (for readability), also known as the Eccles code:

R1 Faint signals, just audible
R2 Weak signals, barely audible
R3 Weak signals, copyable in the absence of any difficulty
R4 Fair signals; readable
R5 Moderately strong signals
R6 Strong signals
R7 Good signals, such as copyable through interference
R8 Very strong signals, can be heard several feet from phones.
R9 Extremely strong signals

There may have been older reporting systems in ham radio, but this one was proclaimed official by *QST* in 1925 and must date back at least to World War 1. Its long-term impact on the art may be shown by the fact that it wasn't until the end of World War 2 that our receivers' carrier strength indicators were called S meters rather than R meters! But as the state of the art grew more refined, dissatisfaction also grew because, although the Eccles code was supposed to indicate readability, the definitions were much more concerned with signal strength. It was also pointed out, in later years, that on a receiver with a number of audio amplifier stages, almost any old signal could be made to conform to the R8 requirements by simply cranking up the audio gain.

Along about 1926, RCA originated a system known as the Traffic Frame Code, primarily intended for use by commercial cw stations. The word "Frame" indicated the order in which the five section report was to be given, that is, Frequency, Relative Strength, Amplitude Modulation, Musicality of note, and Estimated readability. Since each of the five sections contained nine graduations, it's just as well that this one was speedily forgotten. But the Frame code was indeed an important part of the family tree because the M for Musicality of note section was lifted in toto to become the T for "Tone" part of our R-S-T code. Witness the original nine parts with the frequent references to musicality:

1 Extremely rough, hissing note
2 Very rough ac note, no trace of musicality
3 Rough, low-pitched ac note, slightly musical
4 Rather rough, ac note, moderately musical
5 Musically modulated note
6 Modulated note – slight trace of whistle
7 Near dc note, smooth ripple
8 Good dc note, just trace of ripple
9 Purest dc note

It's most interesting to note that these nine definitions of a cw note have served us for 40 years without a single word having been changed!

Another early system of signal reporting, intended for use by the then relatively few phone stations, was the Q for Quality code of five divisions:

Q1 Good quality, no hum or distortion
Q2 Good quality, but noticeable hum
Q3 Fair quality because of distortion
Q4 Poor quality because of bad hum
Q5 Poor quality because of bad distortion

From this it may be inferred that hum and distortion were a common part of radiotelephony in those days, which is indeed true (as those of us who were there will attest). If it had been possible to do so, microphones and filter capacitors would have literally been cheaper if fabricated from gold rather than carbon granules and tinfoil.

Meanwhile there evolved a five point reporting system based on the international code signal QSA, "The strength of your signals is . . . " Its final form as adopted by the 1932 Madrid Conference was:

QSA1 Hardly receptible – unreadable
QSA2 Weak, readable now and then
QSA3 Fairly good, readable with difficulty
QSA4 Good, readable
QSA5 Very good, perfectly readable

Even though, here again, readability and strength were somewhat interwoven, these five steps are easily recognizable as the direct ancestor of the R for "Readability" part of our R-S-T system.

Although at the time of its inception, the QSA code was intended to supplant the older nine point R system, hamdom was unaccountably cool to the idea and blithely proceeded to use them both at the same time. During that period, as old-timers will recall, a moderately good phone signal might have been reported as QSA 4 R7 – good signals, such as copyable through interference.

CW stations used the same procedure except the report was preceded by a simple abbreviation to indicate tone, i.e., RAC for rectified ac (or raw ac), NDC for near dc, DC for a nearly pure whistle, and, best of all, PDC for pure, direct current. If the piercing quality of crystal control was evident in those days of mostly self-excited rigs, an X was tacked on ahead of the appropriate group. Thus, a pretty good report in any CW man's log was "Ur XPDC sigs QSA 5 R7 hr, OM."

And so the stage was set for the final (almost) attempt to set up a workable signal reporting system with readability, signal strength and tone in three entirely separate categories.

The first description of the R-S-T code, together with the announcement of its adoption by the ARRL, appeared in *QST* for October, 1934. The readability and tone sections of the new code as then set forth were exactly as they are today – remarkable when one considers the technical changes which ham radio has undergone during the intervening years. As proposed in 1934 the S for strength portion contained only 5 steps:

1 Faint – signals barely perceptible
2 Weak signals
3 Fairly good signals
4 Good signals
5 Very strong signals

Long accustomed to the multiple possibilities offered by the old R1 through 9 code, the fraternity voiced immediate dissatisfaction over this new, apparently oversimplified version. Also "R" meters were just becoming available on superhet receivers and the gaps between S points looked very wide indeed.

Consequently, only one year later[1] in October, 1935, four additional steps were interspersed to bring the total up to the magical nine total. The added steps: very weak signals, fair signals, moderately strong signals and strong signals. As an afterthought, S9 was changed to "extremely strong signals."

During the years since then, there has been no end to the argument over what constitutes an extremely strong signal. Perhaps our new friends, the Citizens Banders, have the answer – they've simply added an "S10!"

. . .WØHKF

[1] Curiously, although the arrangement was officially in use for only a year, it gave rise to the abbreviated report, still heard occasionally, "Read you 5 by 5" or "5 square."

Lazy Lechers

As was mentioned in the article of W2DXH in *73*, July '66, Lecher wire systems are of questionable value. To the average ham this no doubt is a true and irrefutable statement, and of little value to the vhf or uhf experimenter. However, going into the first stages of second hamhood, the author tried out a pair of Lecher wires last winter.

Since some may ask, "What are Lecher Wires?" and, indeed, some have, a brief description might be in order. Please don't try your secretary's dictionary. Nasty-minded insinuations are all you will find. Just take a double man-sized hank of bare shiny wire, bend it back on itself, stretch tight, and apply a shorting bar of some kind. That is a Lecher wire. Simplicity should not be confused with lack of accuracy. For calibration, measure the distance between nulls or peaks, and convert to meters or frequency. This procedure was plenty good on 5 and 2½ meters in isolated spots where the primary need was to insure you were in the band. For more accurate measurements, a sneaky deal was to use the harmonics of the oscillator of a short-wave receiver to calibrate things. Merely add and subtract 455 and multiply. Meanwhile, back to Lecher wires.

An expensive source of workable wire is aluminum clothesline. Plastic clips cost about 10 cents a dozen with mounting screws. A 1 x 2 piece of wood, a few feet long, is the only requirement. For long term stability, a coat or two of shellac or varnish may help. As for the accuracy and calibration, these are really up to the individual. For an example, the sound and video on channel 7 can be very easily separated. 4.5 MHz at this frequency represents quite good resolution for such a simple instrument. Maintenance costs are extremely low. None!

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Please add 35¢ for shipping

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EASY AMPS

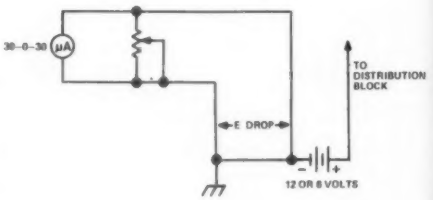
Simple ammeter for your car.

Most amateurs belabor the fact that many of the present day American cars come equipped with those questionably functional "idiot lights." The average amateur, not qualifying as an idiot, finds them extremely difficult to read in determining how much current his rig and other accessories are drawing from an already overloaded battery.

The generally accepted method for monitoring current in a vehicle so equipped is to mount an ammeter somewhere in or on the dashboard, break the dc line at an appropriate place, run a pair of heavy leads through the firewall and connect them to the meter.

This has many disadvantages. The last time I tried this using No. 10 insulated copper wire a voltage drop of approximately 0.7V under a load of 18 to 20 amps was noted, not to mention the job of knocking a large size feed-through hole in the firewall. When installing the old rig in a new car, I decided to take a lazy-type approach to this problem of remotely reading current.

This was accomplished by the simple expedient of inserting a zero center 30-0-30 microammeter from the negative battery terminal to any point on the body of the vehicle where a good ground can be obtained. This has the effect of reading the voltage drop across the negative battery cable which is directly proportional to the current flow. In my case, I found that the meter reading was slightly higher than the actual current. This was proved by inserting a standard 0-30 ampere meter in the dc line and observing the current when the lights or



other accessories were turned on. An ancient wire wound, open type potentiometer was "scrounged" from the junkbox and placed across the microammeter terminals. This was adjusted until both meters read the same. The ammeter was then removed and the dc line closed.

A 10 foot piece of No. 18 insulated wire was then connected to the negative battery terminal. This was guided through the cable hangers and through a convenient small hole in the firewall where it was connected to one terminal of the microammeter, the other terminal going to ground. The pre-set pot was soldered across the terminals. The meter was then mounted in a small panel designed to attach to the steering post.

I now have a device with which I can read current charge and discharge with a fair degree of accuracy.

Remember that this scheme involves wiring that is virtually at the same potential as the vehicle body, therefore the danger of short circuits is non-existent. The main advantages of this simple installation are: elimination of voltage loss at the load; and ease of installation.

. . .W6WDF

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We have immediate customers for your old equipment in any condition. We'll pay guaranteed highest price, shipping, insurance, etc. We'll pay in 24 hours, write or call collect for our high offer. P.S. We'll trade or swap equipment too.

URGENTLY NEED THE FOLLOWING: AN/UPA-38, AN/GMD-1.

NAVY AN/URC-9, Radio Set
AN/S RC-20, 21
AN/SRD-7 D.F.
AN/URD-4 D.F.

AN/VRC-12,
RT-524/VRC
R-442/VRC
MX-2799, MX-6707
and Accessories.
RT-505/PRC-25
AN/PRC-77
AN/VRC-24

AN/TCC-3: AM-682, TA-219

AN/TRC-24:
T-302A, AM-912,3
R-417A, AM-914.5 PP-685A & accessories.

COMMERCIAL AIRCRAFT COMMUNICATIONS:
Collins: 17L-4,7,51X2, 51V3, 618S, 618T, 621A3, 860E-2, 618M, 51R3 578D, 578X, 479S-3, 479T-2; ARC: R-30A, R-38A, R-34A, RT-11A, T-27A, T-25C, R-31A, 21A system, IN-12,13,14. Test Sets: H-14, H-14A, etc.

INDICATORS: ID-2050,I, ID-387, ID-257, ID-663, ID-1103, ID-637, etc.; all Collins, Weston, and A.R.C. indicators and control units.

TEST EQUIPMENT
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AN/URM-25
AN/URM-26
SG-1A/ARN
SG-2A/GRM
AN/USM-207
SG-13/ARN
AN/ARM-22
SG-582/U
AN/ARM-25
AN/ARM-68
AN/URM-48
AN/ARM-22
AN/ARM-66
AN/USM-116
AN/ARM-65
SG-66A/ARM-5
AN/URM-43
AN/UPM-98
AN/USM-117
MD-83A/ARM
AN/UPM-99
AN/USM-16
TS-723/U
OS-8E/U
TS-757
PT-434/ASA-13
TV-2C
TS-621
TV-7
TS-710
TS-510A
AN/URM-52
AN/USM-44
AN/TRM-3
SG-24/TRM
ME-30C/U
AN/PSM-6B
AN/GPM-15
AN/PSM-4B
We also buy all H-P, Boonton, ARC, GR, Bird, Measurements, TEK, etc.

RECEIVERS: AN/APR-13, 14, 17; R-388, R-388A, R-390, R-390A, R-391, R-392, R-220, R-389, CV-43C, R-1125, R-1051, CV-253/ALR, 51J-2,3,4, AN/URR-, AN/FRR-, etc.

AIRCRAFT EQUIPMENT:
AN/ARC-34,38,44, 131, 45,51,54,58,73; AN/ARN-14,21,54,56,59,65,67,52V. AN/APN-141, 133.

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MILITARY ELECTRONICS, CORP.

76 BROOKSIDE DRIVE
UPPER SADDLE RIVER
NEW JERSEY 07458
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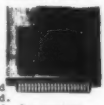
NEW IC TIMER (NE 555)

FEATURES

- TIMING FROM MICRODECONDS THROUGH 1 Hr.
- CAN EITHER FREE RUN OR LATCH
- ADJUSTABLE DUTY CYCLE
- TIME DELAYS CAN BE RESET
- TEMPERATURE STABILITY 0.005% PER °C
- OPERATES FROM 4 to 15 VOLTS FOR 1% CHANGE IN TIMING
- TIMING CAN BE CHANGED 10:1 WITH CONTROL
- VOLTAGE
- OUTPUT CAN SOURCE OR SINK 100mA

$1.50 Each

UNIVERSAL DECADE COUNTING UNITS



1. Easy to read single plane LED or Filament-type Readout with wide angle viewing.
2. BCD Outputs available
3. Readout Lamp Test
4. Selectable Ripple Blanking
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6. Counter Reset
7. Plug-in Module
8. Molex Sockets for all IC's & Readout
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10. Your choice of 1 to 6 decades on one P.C. board.
11. Grouping of 2 or more readouts on the same card, for custom designed appearance.
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13. First in a series of universal plug-in modules to be introduced soon; for frequency counting, time measurements, event counting, DVM, magnitude comparison, etc.
14. Well documented application note with step-by-step assembly and hook-up instructions.

Price (Per Decade):

Basic Unit consisting of 7490, 7447, Filament-type 7-segment Readout....$8.00

Options:
For LED Readouts instead of Filament-type add $2.00
For 7475 Latch add....$1.25
For 74176 instead of 7490 add.....$0.50
For 74192 instead of 7490 add.....$1.00
For 74196 instead of 7490 add.....$0.75
For fully assembled and tested unit add.....$2.50

We have had many calls asking us if the components we sell are rejects? We would like to announce here that EVERY item sold by us is manufacturer's FIRST-RUN, fully tested and in perfect BRAND NEW condition. These parts are purchased through huge blanket orders mainly for our manufacturing requirements, and we are happy to pass on the savings to you. All parts are GUARANTEED to be brand new, NOT EVEN SURPLUS NEW; but first-runs, manufactured within the last 9 months.

Manufacturers, schools, universities, hobbyists; we can save you hundreds of dollars on your requirements, while offering a permanent source you can depend on indefinitely, not until one's surplus stock is exhausted.

DELIVERY PROBLEMS? Every item advertised here will be shipped within 24 hours after receipt of your order (3 days for orders paid for by personal checks), or we will allow you a 10% discount on back-ordered items. For SUPER-FAST service give us a call and we will ship COD the same day.

Incandescent Type of 7-segment display. With right-hand decimal point. Rated 8mA per segment at TTL supply of 5V. Design life of 50,000 hours. Needs a 7447 as a driver. In DIP Package. Each $3.25

MOLEX IC SOCKET PINS: Use these economical pins instead of soldering your IC's to PC boards. Sold in continuous strips in multiples of 100 pins only.
100 for $1.00; 200 for $1.80; 300 for $2.60
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700 for $5.80; 800 for $6.60; 900 for $7.40
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VOLTAGE REGULATORS. Internally-set, overload and short-circuit proof regulators need no external components to set. With data sheet and application notes. TO-3 Package.
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TTL DIGITAL IC'S

7400	29¢	7450	29¢	74150	$2.00
7401	29¢	7451	29¢	74151	$1.40
7402	29¢	7453	29¢	74153	$1.95
7403	29¢	7454	29¢	74154	$2.50
7404	30¢	7460	29¢	74155	$1.75
7405	30¢	7470	65¢	74156	$1.75
7406	70¢	7472	60¢	74157	$1.95
7407	70¢	7473	60¢	74158	$1.95
7408	30¢	7474	50¢	74160	$1.95
7409	30¢	7475	$1.00	74161	$1.95
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7411	30¢	7480	90¢	74163	$1.95
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7445	$1.75	74122	90¢		
7446	$1.65	74123	$1.40		
7447	$1.65	74141	$1.50		
7448	$1.55	74145	$1.50		

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NE501	$2.25
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NE561	$4.75
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710	50¢
711	50¢
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1N270	15¢	1N4002	15¢
1N751A	30¢	1N4154	15¢
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All values are available in both, axial or upright (PC Board) mount. PLEASE INDICATE YOUR CHOICE.
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5, 7.5, 10, 12, 15, 20, 22, 25, 27, 30, 33, 39, 50, 56, 68, 75, 82, 100, 120, 150, 180, 200, 220, 250, 270, 300, 330, 360, 390, 470, 500, 560, 680, 750, 820, 1000, 1200, 1500, 1800, 2000, 2200, 2500, 2700, 3000, 3300, 3900, 4700, 5000µuF. EACH.....10¢
0.01uF. Each.....11¢ 0.02uF. EACH.....12¢

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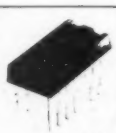
1.0 uF, 3V.....25¢ 2.2 uF, 3V.....30¢
0.1 uF, 10V.....12¢ 0.2 uF, 10V.....20¢
0.47uF, 10V.....30¢ 0.01uF, 16V.....10¢



LED 7-SEGMENT DISPLAY

$4.95 Each

50-99 $4.75
100-999 $4.50
1000-up $4.25

Large ½" 7-segment LED readout similar to the popular MAN-1 but with improved brightness. Has left-hand decimal point. Fits in a DIP socket. Expected life: Over 100 Yrs Regularly $12.95 in single lots. These are BRAND NEW with full data sheet and 4-page MULTIPLEXING Application Note. Needs a 7447 for driver and ONE CURRENT-LIMITING RESISTOR PER SEGMENT. We can supply you with one or ten thousand FROM STOCK. Also available, ±1 OVERFLOW digit at the same prices. Mixing of Regular & Overflow digit allowed.

Package of 8, 470 Ω, ¼W limiting R's.....30¢

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NEW & USED TV CAMERAS & ASSOC. EQUIPMENT

CLOSED CIRCUIT TV CAMERA $279.00

#6079 – KOYO model JL-451 CCTV camera. Brand new, solid state using type 7262A vidicon with wide range ALC, approx. 550 lines video resolution w/both RF & Video outputs. Power Supply 117V 60 cs. 13V A. 10 3/8x5 3/8x3 9/16; Wt. 6 1/2 lbs. Complete with 1" std. 'C' mount lens. Regular Price $395.00 – Special Spring Price only $279.00 complete with lens.

$149.95

MODEL TK-204V

#18,361 – Brand new model TK204 V, video output only camera using a std. 1" vidicon type 7038, completely solid state. Freq. Response 4.5mc giving approx. 450 lines resolution; 600:1 ALC, 117/220V 50/60 cs. 6.6"W 9.5"D 3.2"H. Wt. 5.6 lbs. Regular Price $269.00 Special Spring Price compl. w/1" lens $149.95

SOLID STATE 9" VIDEO MONITOR

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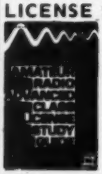

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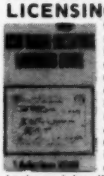

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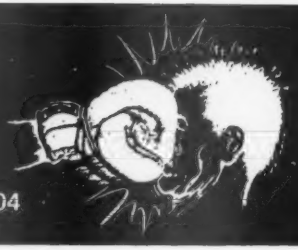

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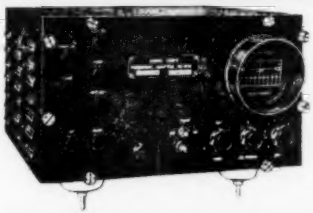

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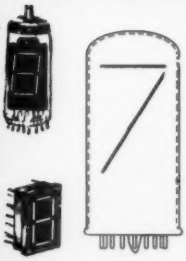

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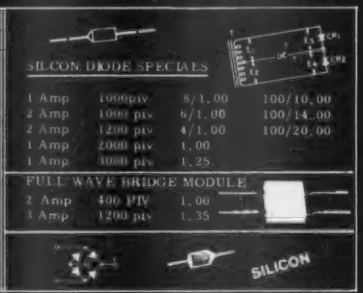
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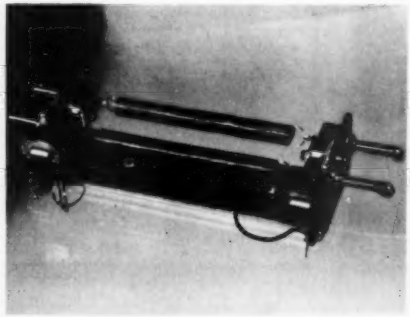

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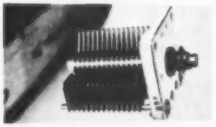

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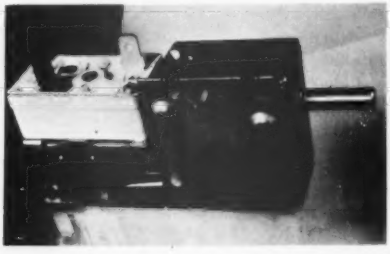

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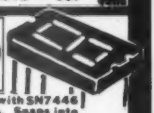

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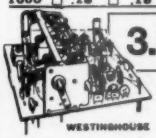

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JAPAN	14	14	14	14	7A	7	7	7	7	7A	14	14
MEXICO	14	14	14	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	14	7A	7B	7	7	7	14	14	14
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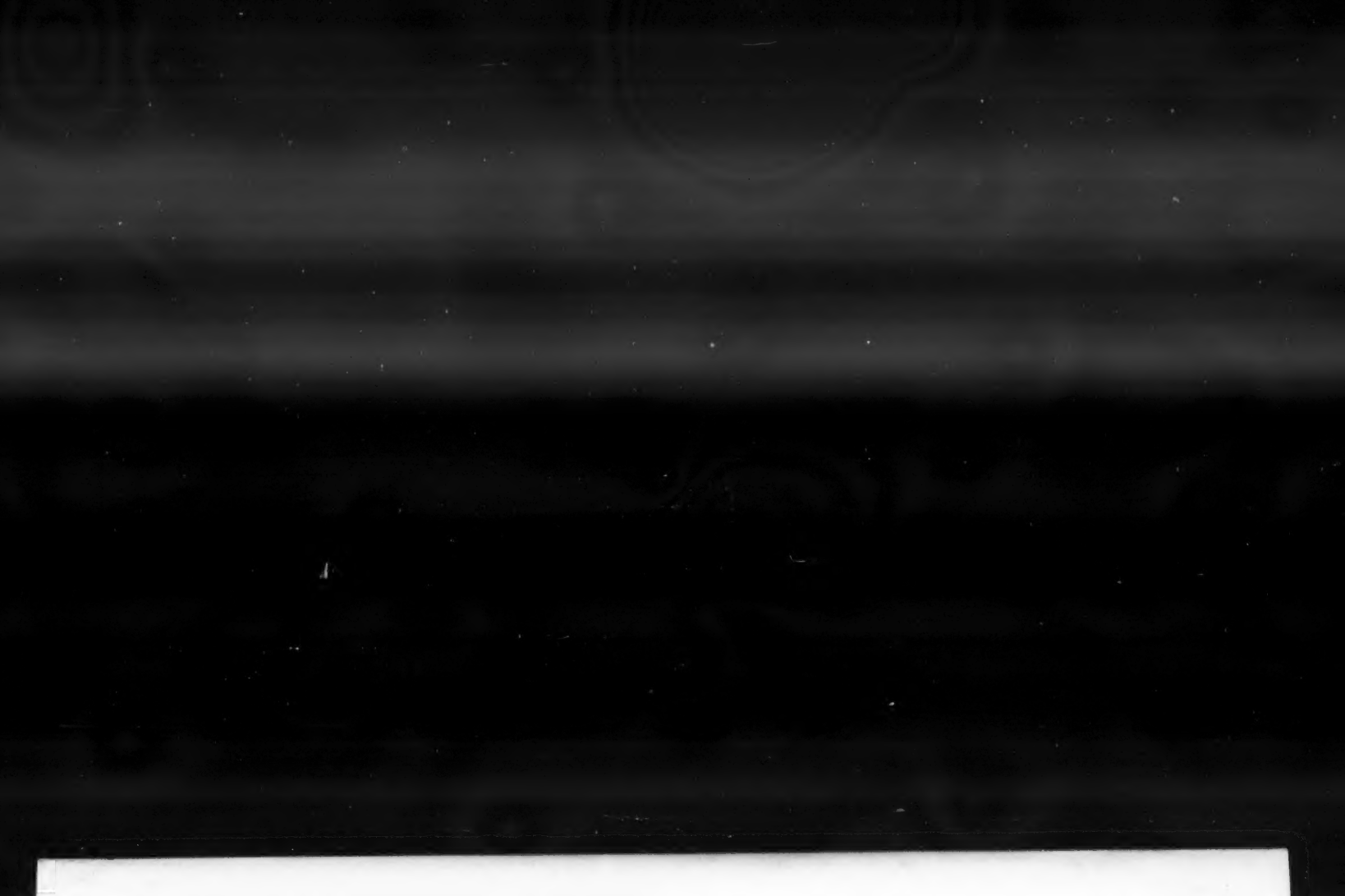
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